# A REVIEW OF SOME ENGLISH PALAEOGENE NASSARIIDAE, FORMERLY REFERRED TO *COMINELLA*



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CONTENTS



## SYNOPSIS

English Palaeogene prosobranch gastropod species, previously assigned to the Tertiary and living New Zealand genus *Cominella* (Buccinidae or Cominellidae of Buccinacea), are reviewed. New genera are described to accommodate these English species and their European relatives. They are assigned to the Nassariidae (Buccinacea) on the characters of their fascioles and columellae, in particular the presence of a terminal columellar plait. Like living Nassariidae,

they probably lived in warm seas, in shallow water, possibly intertidally. Their known distribution, both in Europe and beyond, is summarized. *Colwellia* nov. gen. occurs both in the European and the United States west coast Eocene (California to Washington State) where it is represented by species usually assigned to *Molopophorus*. Most other species assigned to the latter genus also appear to belong to the Nassariidae. Its type species, *M. striatus* (Gabb) seems not to belong to the family but to be a synonym of *Brachysphingus* which is shown to lack the characteristic terminal columellar plait. Palaeocene *Thanetinassa* nov. gen. shows certain similarities to the later Palaeogene *Phos*-like (Buccinidae) genera *Tritiaria*, *Buccitriton* and to *Sagenella* (Nassariidae), all from the U.S. south-eastern province. This publication is a preliminary to a more intensive review of the Nassariidae and their possible relationship with the *Phos*-like group.

The following new genera of Nassariidae are described:—*Pseudocominella*, *Desorinassa*, *Whitecliffia*, *Colwellia*, *Keepingia* and *Thanetinassa*. The following new species are described from the Hampshire Basin. Eocene (Ypresian):—*Desorinassa williamsi*; Late Priabonian:—*Pseudocominella semicostata*, and *Whitecliffia tumida*. Several Palaeogene species, including *Buccinum canaliculatum* J. de C. Sowerby and *B. montense* Briart & Cornet are shown to be unrelated to the Nassariidae.

## INTRODUCTION

THE present study started as a result of a request for identification of a specimen from the English Lower Eocene which proved to belong to an undescribed species. It is one of a small group of species in need of revision which are normally assigned to the living New Zealand genus *Cominella*.

The genus *Cominella* was erected by Gray (1850 : 72) who assigned to it nine living species from New Zealand, Australia and South Africa. Iredale (1918 : 34) designated as type species the first mentioned, *Buccinum testudineum* Lamarck from New Zealand. He also selected the living South African species *Buccinum cinctum* Röding (= *porcatum* Gmelin, preoccupied) as type species of his new genus *Burnupena*.

During the latter part of the nineteenth century the name *Cominella* came to be almost universally applied to a group of European species, most of which are now assigned to the new genera described here. The designation by Cossman (1901 : 149) of *Buccinum porcatum* Gmelin as type species of *Cominella* is invalid as it was not among those listed by Gray. Cossmann, unfortunately, also based his definition of the genus partly on two European Palaeogene species which he regarded as 'plesiotypes', *Buccinum gossardi* Nyst and *Buccinum desertum* Solander. He regarded *Molopophorus* from the Eocene of California as a probable synonym of *Cominella*, and (1901 : 201) stated that *Molopophorus* should be eliminated from the Nassidae (now known as Nassariidae), though expressing doubts as to the accuracy of Gabb's figure of the lectotype of *M. striatus* Gabb, the type species of *Molopophorus*. Later Cossmann indicated that he had no remaining doubts as to this synonymy after examining the type figures of another species, *Molopophorus gabbi* Dall (1909 : 45, pl. 3, fig. 8), from the Oligocene of Oregon (see Weaver, 1942 : 466). Subsequent American workers (Stewart, 1926 : 389; Vokes, 1939 : 140–141) have suggested a connection between *Molopophorus* and European Palaeogene species assigned to *Cominella*. In the present study four United States West Coast species, previously

assigned to *Molpophorus*, are recognized as belonging to *Colwellia*. A re-examination of the lectotype of *Molopophorus striatus* suggests that it is a juvenile *Brachysphingus*, and that neither belong to the Nassariidae (see p. 209). All other species normally regarded as belonging to *Molopophorus* appear to have little in common either with its type species or with *Brachysphingus* and seem to belong to more than one undescribed genus. Gabb (1869 : 156, 157, pl. 26, fig. 36) in describing *Molopophorus* as a subgenus of *Bullia*, compared it with *Bullia* (*Buccinanops*) *monilifera* (Kiener) now living on the Atlantic Coast of South America. Not only the type species of *Molopophorus*, but also species assigned to that genus later, and *Brachysphingus* have been generally accepted by American authorities as members of the Nassariidae.

Some of the gross shell characters of these American Tertiary forms and the European Tertiary genera described in this paper closely resemble those found in modern Nassariidae and in *Cominella* which have fasciole regions of a broadly similar type (see Text-fig. 1). The growth lines on the neck region are bent aborally to form a ridge confluent with the adapical margin of the track of the anterior notch. The deepest point of the asymmetrically U-shaped notch is usually fairly close to the ridge. Below the ridge there is some variation. The growth lines range from regular to imbricate and are reverse S-shaped, but the upper and lower halves of the S may be of varying proportions and curvature. In true *Cominella* the notch corresponds with a raised ridge, as opposed to a groove observed in many definite Nassariidae and the fossil genera under consideration. A more important feature that the latter share with definite Nassariidae is that the columella is bent strongly to the left and bears a terminal plait. *Cominella* lacks this plait and its columella is not so strongly bent.

On these grounds these fossil genera may be assigned with confidence to the Nassariidae rather than to the Buccinidae (as constituted by Wenz, 1941 : 1151–1200; 1943 : 1201–1210), which includes the Cominellidae of Powell (1929 : 57).

Homoeomorphic, superficial, similarities between these genera and *Cominella* include the frequent development of a subsutural platform and concave ramp and the rather flexuous but basically orthocline growth lines.

*Buccinum canaliculatum* (J. de C. Sowerby, 1823 : 14, pl. 415, fig. 2) from the Barton Beds of the English Upper Eocene was placed in *Cominella* by Newton (1891 : 168). Cossmann (1901 : 121–123, pl. 8, figs 13, 14) selected it as the type species of his monotypic genus *Bartonia*. He compared it with *'Cominella' deserta* from the same formation, pointing out the differences in the features of their apertures and canals. *Bartonia canaliculata* lacks a columellar plait, its columella curves to the left and is not truncated, no ridge is formed at the adapical margin of its fasciole and the growth lines in the fasciole region are less strongly curved than in *Pseudocominella* (Text-fig. 1). It is hoped that *Bartonia*, which remains assigned to the Buccinidae (*sensu* Wenz, 1941–1943) will be treated in a future paper.

In this paper, five genera, *Pseudocominella*, *Desorinassa*, *Colwellia*, *Whitecliffia* and *Thanetinassa* are described to accommodate British and European Tertiary species previously assigned to *Cominella*. The opportunity is also taken to describe a sixth genus of the group, *Keepingia*, though it does not occur in England. The

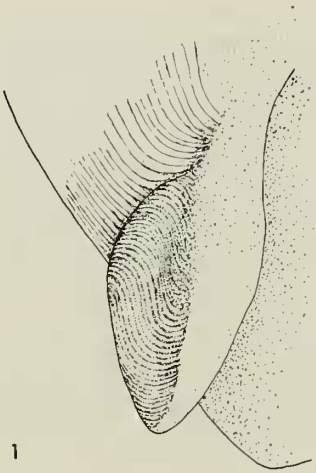






FIG. 1. Fasciole and columellar details of 1, *Cominella testudinea* (Lamarck), type species of *Cominella* (fam. Buccinidae) Recent, New Zealand, BMZD 1844.7.29.36, showing ridge above fasciole and no columellar plait (also see pl. 9, figs 11a, b), ×5. 2, *Sphaeronassa mutabilis* (Linné), type species of *Sphaeronassa* (fam. Nassariidae), Recent, Bay of Naples, BMZD 19722, showing strong ridge above fasciole, strong terminal columellar plait with weaker plaits above, ×5. 3, *Pseudocominella deserta* (Solander) type species of *Pseudocominella*, Upper Eocene, Lower Barton Beds Bed B, Barton, GG 19675 (*Ru*), showing strong ridge above fasciole, imbricate growth lines of fasciole, strong terminal columellar plait with weaker plaits above (see also pl. 1 figs 7a, b), ×5. 4a, b, *Bartonia canaliculata* (J. de C. Sowerby), type species of *Bartonia* (fam. Buccinidae), Upper Eocene Lower Barton Beds, Barton. 4a, GG 6897/1 (*Wr*), apertural view, ×2·5; 4b, GG 6897/2 detail, showing no sharp break between neck and fasciole and no columellar plait, ×7·5.

gross shell characters of these new genera are fairly similar, the main differences being in the form of the apical whorls, strength of sculpture and the strength and character of the ridging in the fasciole region.

The known distribution of these genera, in Europe and beyond, is summarized on Table 1. We have examined numerous references to *Cominella*, '*Nassa*', *Molopophorus* and *Brachysphingus* but have found few plausible extra-European occurrences of the genera newly described here.

The recognition of these additional Palaeogene members of the Nassariidae affects our understanding of the evolution of the family. It is intended to pursue this topic in a future paper.

Although it is hoped that the specific and generic diagnoses will be sufficient to distinguish different taxa, the descriptions given here are detailed. In addition, the variation in a species from locality to locality has been illustrated and commented on as fully as possible. This policy is justified because apparently good illustrations and descriptions have proved inadequate and misleading, so that important points have only been resolved by the study of actual specimens. To quote only a few examples, it seems incredible that the European Tertiary species discussed herein should have been accepted for about one hundred years as members of the Recent New Zealand genus *Cominella* which belongs to another family, that *Buccinum montense* Briart & Cornet was not recognized as being congeneric with many Eocene species assigned to *Pollia* of the Buccinidae, that *Bartonia canaliculata* (J. de C. Sowerby) should have been considered congeneric with *Buccinum desertum* Solander, and that the French Lutetian and Auversian *Buccinum fusiforme* Deshayes should have been considered synonymous with the Bartonian *B. desertum* Solander rather than with the Auversian *Strepsidura armata* J. de C. Sowerby.

## MATERIAL STUDIED

This study of English specimens is based primarily on the collections in the British Museum (Natural History). Material in the Sedgwick Museum, Cambridge, the Geological Survey Museum, London, the Sandown Museum, Isle of Wight, Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris, and École des Mines, Paris has also been examined. In addition, much valuable information has been obtained from the stratigraphically detailed labels of several private collectors. To indicate the authenticity of various records, the collector is named when known.

The most important single collection is that of F. E. Edwards in the British Museum (Natural History). Much of his collection was obtained from workers such as Henry Keeping, who also collected the fossils from Huntingbridge listed by Fisher (1862 : 79), and it was enriched by exchange with foreign palaeontologists. It forms the basis of many published faunal lists (von Koenen, 1864; Judd, 1880; Keeping & Tawney, 1881). The British material in the Edwards collection was catalogued by Newton (1891), who included many of Edwards' manuscript names. Both the Edwards collection and Newton's catalogue may be presumed to be the

TABLE I

Distribution of some early Nassariidae

| | Stage | England | France | Belgium Holland | Germany | North America (West Coast) | Other Occurrences | |
|---|---|---|---|---|---|---|---|---|
| MIOCENE | Tortonian | — | — | — | — | — | — | |
| | Burdigalian | — | *K. tarbellica* | — | — | — | — | |
| | Aquitanian | — | ***K. praecedens*<br>***K. aturensis* | — | — | — | — | |
| OLIGOCENE | Chattian | — | — | *K. bolli* | *K. bolli*<br>*K. cassidaria*<br>***K. uniseriale* | — | — | |
| | Rupelian | — | *K. gossardi* | *K. gossardi*<br>*W. suturosa* | *K. cassidaria*<br>*W. suturosa* | — | **?*K. annandalei*<br>(Nari stage) | (W. Pakistan) |
| | Lattorfian | — | — | *P. bullata*<br>*K. gossardi*<br>*W. suturosa* | *P. bullata*<br>*P. bullata aspera*<br>*W. suturosa* | — | — | |
| EOCENE | (Late Priabonian) | *P. deserta*<br>*P. semicostata*<br>*C. flexuosa*<br>*W. suturosa*<br>*W. tumida* | — | — | — | — | — | |
| | Bartonian (early Priabonian,) | *P. deserta*<br>*P. solanderi* | — | — | *P. deserta* | *C. bretzi*<br>*C. tejonensis* | — | |
| | Auversian | *P. armata* | *C. auversiense*<br>*P. armata* | — | — | | | |
| | Lutetian | — | *P. armata* | — | — | *C. antiquata*<br>*C. cretacea* | | |
| PALAEOCENE | Cuisian | — | *D. acies*<br>*D. ovata* | — | — | | | |
| | Ypresian | *D. williamsi* | — | — | — | | **?*D. bonnecarrei* | (Togo) |
| | Sparnacian | — | — | — | — | — | | |
| | Thanetian | *T. bicorona*<br>*D. desori* | *T. bicorona*<br>*D. desori*<br>*D. lata* | — | — | — | **?*D. suprocostata* | (Austria) |

(note: specimens of species marked ** have not been examined.)

## EXPLANATION TO TABLE 1

The table is compiled from:
(a) England (this paper).
(b) France: Cossmann, 1901; Deshayes, 1865; Glibert, 1960, 1963; Peyrot, 1927.
(c) Belgium & Holland: Albrecht & van der Valk, 1943; Glibert, 1954, 1957.
(d) Germany: Beyrich, 1854; Glibert, 1960, 1963; Sandberger, 1863; von Koenen, 1889.
(e) North America: Vokes, 1939; Weaver, 1942.
(f) Austria: Traub, 1938.
(g) Togo: Furon & Kouriatchy, 1948.
(h) West Pakistan: Vredenburg, 1925.

Notes. An examination of the holotype and paratype (Bayerisches Geol. Landesamt no. 3080, 3081) of *Northia* (*Cominella*) *angusta* Hölzl (1958 : 244, pl. 20, figs 16–16a) suggests that the species should be referred to *Dorsanum*. *Buccinum montense* Briart & Cornet (1871 : 30–31), referred by subsequent authors to *Cominella* is a *Pollia* (Buccinidae). Many North American species ranging from Paleocene to Miocene in age are omitted from this table. They belong to undescribed genera (see p. 209) close to those described herein. An examination of the holotype of *Cominella dertonensis* Bellardi (1882: 3, pl. 1 figs 1a, 1b) from the Middle Miocene (Tortonian) of St Agata-fossili, Italy (Instituto di Geologia, Turin, no. 11436) shows that it is not a member of the Nassariidae and is in no way related to *Pseodocominella*.

Abbreviations of generic names
*C., Colwellia; D., Desorinassa; K., Keepingia; P., Pseudocominella; T., Thanetinassa; W., Whitecliffia.*

main sources of the records of species in Britain quoted by Continental authorities such as von Koenen and Cossmann. Keeping's own collection in the Sedgwick Museum, Cambridge, is of particular value because of the reliability of his labels.

The publication (1933) of the late E. St. J. Burton's letter classification of horizons in the Barton Beds at the type locality Barton-on-Sea has enabled later collectors to indicate horizons more precisely than hitherto. The faunal list published by Burton was by no means complete. His own collection, now in the British Museum (Natural History), is not as valuable as it might have been since he often arranged specimens of a particular species from several horizons in the same box.

In the systematic descriptions, the localities and horizons of material which we have examined are given after the synonymy, under the heading 'Material Studied'. It has not been considered necessary to list here material in other Museums which merely complements the British Museum collections unless the record is of particular interest.

Under the subsequent heading 'Further Occurrences', we give records in the literature of those other localities and horizons from which we have not studied material. To avoid undue repetition, we have omitted those records that were probably based on the specimens which we have studied.

### Explanation of abbreviations referring to sources of specimens

*ANSP*, Academy of Natural Sciences of Philadelphia; *CAS*, California Academy of Science; *Cu*, D. Curry Colln.; *Ed*, F. E. Edwards Colln.; *EMP*, École des Mines, Paris—invertebrate collections now being transferred to Laboratoire de Paléontologie, Institut de Géologie, Université de Paris, Orsay-91, France, under direction of M. J. Manivit; *Ho*, M. J. Hoare Colln.; G or GG (followed by number), Department of Palaeontology, British Museum (Natural History); *IRScNB*, Institut Royal des Sciences Naturelles de Belgique, Bruxelles; *Je*, P. Jennings Colln.; *K*, H. Keeping Colln.; *K&T*, H. Keeping & E. B. Tawney Colln.; *Le*, D. N. Lewis Colln.; *MNP*, Institut de Paléontologie, Muséum National d'Histoire Naturelle, Paris; *Nu*, C. P. Nuttall Colln.; *Ru*, A. J. Rundle Colln.; *St. J. B*, E. St. J. Burton Colln.; *Sedg. Mus.*, Sedgwick Museum, Cambridge; *Sand Mus.*, Sandown Museum & Public Library, Sandown, I.O.W.; *S*, F. C. Stinton Colln.; *U.Cal.*, Museum of Paleontology, University of California, Berkeley; *Wr*, A. Wrigley Colln.; *ZD*, Recent Mollusca Section, Department of Zoology, British Museum (Natural History).

## LOCALITIES AND HORIZONS

Many of the British localities are still in existence, are well-known and need no further introduction. Some others, notably the New Forest (Hampshire) localities of the Bracklesham and Middle Headon Beds are either poorly known or are no longer accessible. Curry (1958) gives details and map references to most.

The following points should be noted about locality names attached to the Edwards Collection:

1. Bramshaw, Upper Bracklesham Beds, is described (Curry, 1958 : 70) under Shepherd's Gutter Bed.

2. Roydon, Middle Headon Beds, refers to Royden Manor brick pit (now overgrown) at Nat. Grid SU 320005. Curry (1958 : 29) discusses this locality under the heading 'Brockenhurst Beds'. The section was described by Keeping & Tawney (1881 : 113 and 114 footnote), the latter refers to the fact that Keeping collected the material in the Edwards Collection.

3. Brockenhurst, Middle Headon Beds. Specimens in the Edwards Collection are labelled either Brockenhurst or Whitley Ridge. Keeping & Tawney (1881 : 109) write 'The greater part of the fossils from Brockenhurst were collected by the hands of one of the authors (i.e. Keeping) and . . . dispersed into the various public and private collections. They were obtained from the (railway) cutting at Whitley . . . about (1858, when an extra track was being laid). In a footnote (pp. 109–110), they point out that they both visited the cutting in the summer of 1880, and that the rich (fossiliferous) zone would never be seen here again but that fossils could still be obtained from the spoil heaps (left from the cutting for the original single-track railway in about 1838). As it is clear from a further footnote (p. 114) that Keeping collected the Royden and Lyndhurst fossils in the Edwards Collection, it is more than likely that the same applied for Whitley Ridge. A possible explanation for some of Edwards' material being labelled 'Brockenhurst' is that it was obtained from the spoil-heaps. It seems extremely unlikely that the material came from the Victoria Tile Works at SU 316034. This locality was not mentioned by Keeping & Tawney (1881). It was in existence by 1890 and was normally worked to only a shallow depth as the weathered material near the surface produced the best-coloured products, so that the Brockenhurst shell bed was seldom exposed (Davis, 1952 : 215–216). The foregoing, however, suggests that Davis might have been mistaken in stating that Edwards had worked the local exposures. Whitley Ridge Cutting is the type locality of the Brockenhurst Beds (Curry, 1958 : 29).

4. Lyndhurst, Middle Headon Beds. Edwards' specimens were probably collected by Keeping in 1858 from pits dug on Lyndhurst Hill, to the west of Lyndhurst, the Brockenhurst Bed outcropping at about the 200 ft contour (Tawney, 1883).

The Brander Collection locality 'Hordwell' (= Hordle) quoted by Solander (1766) was the nearest village to the Barton coastal section before Barton itself was built and named.

The Middle Headon Beds have been regarded by most British workers as being of Lower Oligocene (Lattorfian) age. Recent nannoplankton zonation work by Martini & Ritzkowski (1968 : 244–247), Martini (1969 : 117–159), and Martini & Moorkens (1969 : 125–127) show that the Headon Beds are late Priabonian and that some German localities, previously regarded as Oligocene are distinctly pre-Lattorfian. Westeregeln, in part, is now regarded as being approximately equivalent to the Upper Barton Beds.

The ages accorded here to French Paris Basin localities are based on the lists given by Glibert (1960 : 3–5), and by reference to Fritel (1910).

## MODE OF LIFE

*Pseudocominella* and its relatives appear to have lived in shallow water. *Thanetinassa bicorona*, according to Briart & Cornet (1871 : 31), is very common at some French localities, notably Châlons-sur-Vesle in the Sables Inférieurs—a shallow-water sandy deposit. The species also occurs in the coarsely-grained Thanet Sands in England. No species of the group are known from the London Clay. The only British species occurring in rocks of equivalent age is *Desorinassa williamsi* from the shallow-water Bognor Rock. *Pseudocominella armata* is rare and occurs in the rich fauna of the Upper and more clayey part of the Bracklesham Beds. No species is known from the more sandy Lower Bracklesham Beds. In the Barton Beds, species of *Pseudocominella* are known from Horizons A2 to H. *P. deserta* is never common. From the appearance of the specimens it would seem that most were obtained from the extremely fossiliferous Horizon E. *P. solanderi*, however, is extremely common in the lenticular, sandy, shell drifts of Horizon A3. Members of the group also occur in the Brockenhurst and *Venus* Beds of the Headon Series. These two latter beds represent periods of shallow marine deposition in a largely fresh and brackish water succession.

Turning again to the European Continent, many of the occurrences are consistent with a shallow-water mode of life. Examples include *P. armata* in the Calcaire Grossier and *Keepingia gossardi* in the Sables Supérieurs of the Paris Basin, *K. gossardi* and *Whitecliffia tumida* in the Belgian Oligocene and *K. cassidaria* in the late Oligocene deposits of the Mainz Basin. Finally, we note the occurrence of species of *Keepingia* in the Lower Miocene of the Bordeaux region in conjunction with *Nassarius*, *Dorsanum* and *Cyllene*, all living genera of the Nassariidae.

Nearly all the present day Nassariidae live in very shallow water and many intertidal species of the three most important genera, *Nassarius* s.l., *Bullia* and *Buccinanops* are known. *Dorsanum* and *Cyllene* are rare but are known only from shallow-water.

Considering only the British species of the *Pseudocominella* group, it would seem unlikely that either *P. armata* or *P. deserta* was intertidal. The evidence in the case of the other species is not clear cut; any of them could well have been intertidal but there is no proof. Such a mode of life would help to explain the rather sporadic fossil record of the group; inshore deposits are relatively often eroded after deposition. The seas in which these forms lived would have been considerably warmer than those around Northern Europe now. At the present day the family is important in warmer waters, mostly within 40° North or South of the Equator. The occurrence of a few species of *Nassarius* s.l. in Northern European seas may be due to the warming influence of the Gulf Stream. Modern members of the family are carrion-eaters (Fretter & Graham, 1962 : 522).

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Many collectors have allowed us to study their well authenticated material and have willingly presented to the British Museum (Natural History) those specimens that have been asked for. For such help we therefore wish to thank Messrs D.

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## SYSTEMATIC DESCRIPTIONS

Order NEOGASTROPODA

Superfamily ***BUCCINACEA***

Family ***NASSARIIDAE***

***PSEUDOCOMINELLA*** gen. nov.

(Pls 1–3; Pl. 4, figs 1–3)

TYPE SPECIES. *Buccinum desertum* Solander, 1766.

DIAGNOSIS. Bucciniform; moderate sized, normally attaining an adult height of between 20 and 35 mm; protoconch of three convex, naticoid whorls; form of transition into teleoconch unknown; teleoconch of up to seven whorls; aperture broad, only slightly constricted anteriorly, about two-thirds height; posterior siphonal notch present; fasciole narrow, rugose and bounded adapically by a strong ridge and abapically by a strong fold and corresponding with a groove on the external shell surface; spiral ribbing on fasciole sometimes seen on juvenile shells; columella bent to the left and terminating in a raised diagonal plait abapically; columellar callus weak, often not quite obscuring ridge and fold of fasciole which may therefore appear as weak columellar plaits; outer lip usually spirally ribbed within, internal ribs unrelated to external ribs; growth lines wavy, essentially orthocline but bent adorally in sutural region and aborally to meet ridge of fasciole; weak sinus (strombоid notch) present in abapical part of outer lip; flat subsutural platform present; ramp concave; spiral ribbing fairly strong; collabral ribbing usually developed, with a tendency to become spinose at periphery.

OTHER SPECIES ASSIGNED. *Strepsidura armata* J. de C. Sowerby, 1850; *Buccinum bullatum* Philippi, 1847; *B. bullatum aspera* von Koenen, 1889; *Pseudocominella semicostata* nov. sp.; *Cominella solanderi* Cossmann, 1889.

GEOLOGICAL RANGE. Middle Eocene (Lutetian) to Lower Oligocene (Lattorfian).

Remarks. Vokes (1939 : 141) suggested that *'Cominella' deserta* might be congeneric with a group of species from the United States west coast Eocene, usually referred to *Siphonalia* (fam. Buccinidae). *S. bicarinata* Dickerson, in fact, strongly resembles both *P. armata* and *P. semicostata*. Its familial position is obscure. Like Recent *Siphonalia*, it possesses a very weak terminal columellar plait and reverse S-shaped growth lines on the fasciole. It is definitely not a *Pseudocominella*, which has a strongly grooved fasciole and an immediately obvious columellar plait. Some species of *Nassarius* (s.l.) have fairly similar apices and sculpture to *Pseudocominella*. They differ in often having a constriction of the neck above the fasciole whilst the fasciole itself may correspond with a convex fold which is often strongly spirally ribbed. The fasciole of *Strepsidura* (pl. 9, fig. 10) is similar to that of *Pseudocominella* but the former genus may be distinguished by its more twisted columella and by its aperture which is approximately four-fifths shell-height. In addition, its protoconch is larger and rather flattened apically. *Pseudocominella* differs from *Cominella* in the form of the fasciole and the lack of a columellar plait; the two genera are not co-familial.

### ***Pseudocominella deserta*** (Solander, 1766)

(Pl. 1, figs 1–12)

1766 *Buccinum desertum* Solander: 13 (*pars*), pl. 1, fig. 15 (*non* figs 18, 19)
1823 *Buccinum desertum* Brander; J. de C. Sowerby: 14, pl. 415, fig. 1.
1850 *Fusus desertus* Morris; d'Orbigny: 363.
1854 *Buccinum excavatum* Beyrich: 444, pl. 10 (7), figs 1a, 1b, 1c.
1864 *Strepsidura deserta* (Solander) von Koenen: 100.
1866 *Buccinum* (*Cominella*) *desertum* Lowry *et al.*, pl. 3.
1880 *Cominella* (*Buccinum*) *deserta* (Solander) Judd: 154.
1881 *Cominella* (*Buccinum*) *deserta* (Solander); Keeping & Tawney: 116.
1888 *Buccinum desertum* Solander; Gardner, Keeping & Monckton: 626.
1889 *Buccinum desertum* Brander; Bristow *et al.*: 289.
1889 *Buccinum* (*Cominella*) *desertum* Sowerby; von Koenen: 241 (*pars*).
1889 *Cominella deserta* (Solander); Cossmann: 136 (*pars*).
1891 *Cominella deserta* (Solander); Newton: 168.
1901 *Cominella deserta* (Solander); Cossmann: 149, 150 (*pars*).
1901 *Cominella deserta* (Solander); Cossmann, pl. 6, fig. 4.
1933 *Cominella deserta* (Solander); St. J. Burton: 156.
1963 *Cominella deserta* (Solander); Glibert: 67 (*pars*).
1968 *Cominella deserta* (Solander); Martini & Ritzkowski: 244–247.

Lectotype (designated herein). Upper Eocene, early Priabonian, Barton-on-Sea, Hants, figured Solander, 1766, pl. 1, fig. 15, GG 19667 (*Brander Colln.*).

Paralectotype (designated herein). GG 19668, same details, but not figured by Solander.

Material studied. England, Upper Eocene, early Priabonian, Barton Beds, coastal section between Highcliffe and Barton-on-Sea, Hants. Horizon not indicated: GG 19669/1 (figd. J. de C. Sowerby 1823, pl. 415, fig. 1, the central figure); GG 19670/1–25 (*Ed*). Lower Barton Beds, horizon A2, GG 19671 (*Ru*).

Horizon A3, GG 19672/1–3 (*Le*); GG 19673 (*S*); GG 19674/1–13 (*Wr*). Horizon B, GG 19675 (*Ru*). Middle Barton Beds, GG 19676/1–9 (*StJB*); GG 19676/1–6 (*Wr*). Horizon C, (*Je*); (*S*). Horizon E, (*Cu*); (*S*). Upper Barton Beds, Horizon H, GG 19678/1–3 (*Wr*); GG 1151 (*H. A. Toombs*); GG 19725 (*Cu*). Lower Barton Beds, Alum Bay, I.O.W., *Sand. Mus.* 3554 (*J. F. Jackson Colln.*); same (near top), GG 19732 (*Wr*). Upper Eocene, late Priabonian, Middle Headon Beds, Brockenhurst, GG 19679 (*Ed*). Brockenhurst Bed, Whitecliff Bay, I.O.W., *Sedg. Mus.* C 29122 (*K. & T.*). GERMANY, Upper Eocene, early Priabonian, Westeregeln, GG 19680/1–3 (*Ed*).

FURTHER OCCURRENCES. GERMANY, Westeregeln, (Beyrich, 1854 : 444; von Koenen, 1869 : 241; Glibert, 1963 : 67; Martini & Ritzkowski, 1968 : 244–247, with nannoflora indicating a similar age to that of the Upper Barton Beds (Bed H).

DIAGNOSIS. *Pseudocominella* up to 36 mm high; up to seven whorls of teleoconch; mean spire angle 55°–60°; prominent subsutural platform and concave ramp developed; spiral sculpture of narrow ridges often alternately of primary and secondary strength and separated by wide interspaces; collabral ribbing variable in strength and often rather irregular; outer lip ribbed internally; columellar callus developed.

DESCRIPTION. Each whorl is enveloped by the succeeding one just below the periphery. A prominent subsutural platform is developed on the third whorl (first of teleoconch) and reaches a width of 1·5 mm on specimens over 30 mm high. It is normally coronate, being crossed by the axial ribs; in axially multirugose specimens, however, it is often flat on later whorls. It is bordered by a collar bearing on later whorls up to three wavy spiral ribs (two on both the lectotype and paralectotype). The platform is undercut, the sutural ramp being noticeably concave. The whorl shoulder is distinctly adapical to the periphery. On the first and second whorl of the teleoconch one spiral rib marks the margin of the subsutural platform, another the shoulder, and three or four more lie on the rather flat abapical portion of the whorl. These ribs are broad, rather flattened in section, and are separated by narrow grooves. On the third whorl the interspaces broaden and spiral ribs of secondary strength may appear, first on the sutural ramp, then between the primary rib marking the shoulder and the one immediately abapical to it. On later whorls five or six primary spiral ribs of intermediate strength may be distinguished on the increasingly convexly-sided portion of the whorl abapical to the shoulder. These ribs are narrow and are separated by interspaces about double their width. Secondary and sometimes tertiary ribs are often developed with no discernible pattern. On the body whorl between fifteen and twenty-two primary ribs are developed between the shoulder and the adapical margin of the fasciole; up to twenty-five ribs of secondary and tertiary strength may also be present in the same area. On the lectotype there are fifteen primary and fifteen secondary ribs in this region. In the same region there are thirty-nine ribs on the paralectotype but it is difficult to separate them into different orders of strength. The first whorl of the teleoconch bears about thirteen collabral ribs which are well-rounded in section. On the next two whorls the number increases to between fifteen and twenty-five and thereafter remains fairly constant on all succeeding whorls. The lectotype is a

particularly multicostate specimen (see table). The spacing and strength of the collabral ribs often varies on a particular shell as well as between different ones. Their strength is normally inversely proportionate to their number. They are strongest at the shoulder which is often slightly nodose. The ribs are usually weaker on the subsutural ramp but stronger on the subsutural platform. They decrease in strength below the periphery. A variable number of internal spiral ribs occur on the inner surface of the outer lip. They are rather irregularly arranged, stretch back into the aperture for varying distances, and some are discontinuous.

| Dimensions | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| GG 19667 LT | 26·8 | 14·1 | 15·6 | 6+ | 25 | 30 | 9 | 23 | 1·90 | 1·72 |
| GG 19668 PLT | 22 | 13·4 | 14·1 | 6 | 11+ | 39 | 13 | 19 | 1·64 | 1·56 |
| GG 19671 | 8·8 | 5·3 | 5·0 | 4½ | 12 | 23 | 6 | 15 | 1·66 | 1·76 |
| GG 19672/1 | 12·6 | 7·4 | 7·2 | 5 | 20 | 29 | 11 | 16 | 1·70 | 1·75 |
| GG 19673/1 | 17·1 | 10·3 | 9·4 | 5½ | 0 | 36 | 11 | 14 | 1·66 | 1·82 |
| GG 19677/11 | 22·9 | 12·7 | 13·2 | 6 | 15 | 36 | 9 | 21 | 1·80 | 1·74 |
| GG 19677/1 | 30·9 | 15 | 16·5 | 6½ | 14 | 26 | 11 | 16 | 2·06 | 1·87 |
| GG 19670/5 | 34·1 | 19·2 | 19·6 | 7 | 15+ | 32 | 15+ | — | 1·77 | 1·74 |

Key (also used in all following descriptions)
HT, Holotype; LT, Lectotype; NT, Neotype; PLT, paralectotype; PT, paratype.
1, total height (mm)
2, height of aperture
3, breadth
4, number of teleoconch whorls
5, number of collabral ribs on last whorl
6, number of collabral ribs on penultimate whorl (not shown for this species)
7, number of spiral ribs on last whorl
8, number of spiral ribs on penultimate whorl
9, number of spiral ribs inside outer lip
10, height: height of aperture
11, height: breadth

Remarks. *Buccinum fusiforme* Deshayes, from the Lutetian and Auversian of the Paris Basin, was placed in the synonymy of this species by Cossmann (1889 : 136). A re-examination of Deshayes' specimens in the École des Mines (see p. 195) shows that they all clearly belong to *P. armata*. All subsequent continental authors, however, have accepted Cossmann's views. In the synonymy given here it is assumed that their records of French specimens are of *P. armata* and not of *P. deserta*, and that *P. deserta* does not occur in France.

From examining the lectotype and paralectotype it would appear that other authors have correctly interpreted English specimens of the species. The other specimens figured by Solander (pl. 1, figs 18, 19) as *Buccinum desertum* are both lost. J. de C. Sowerby (1823, pl. 415, fig. 2) thought that Solander's fig. 18, and possibly fig. 19 belonged to his new species *Buccinum canaliculatum* (now *Bartonia* see p. 181); these determinations have since been disputed. Cossmann (1889 : 137) identified Solander's figure 18 as *Cominella deserta* var. *solanderi* (Edwards MS). D. Curry (personal communication) points out that Solander's fig. 19 is much more likely to be of *Buccinum lavatum* J. de C Sowerby (now *Pollia*).

In the adult stage *P. deserta* most clearly resembles *P. bullata* (Philippi) (pl. 2, figs 9a, b) from the Lower Oligocene of Latdorf, Germany. The whorl profile of the latter is more evenly convex, the subsutural ramp being barely grooved. Its sculpture, particularly the collabral elements, is weaker, and the first four whorls of the teleoconch are much smoother. In some specimens the collabral ribs on the last body whorl are relatively strong in the peripheral region where they form definite nodes. The spiral ribs on the inner surface of the outer lip are more numerous. Comparisons with *P. armata* and *P. solanderi* are discussed under the latter named.

The records by Morris (1843 : 146) from Bracklesham (as *Fusus desertus* Brander), by Forbes (1856 : 86) from the Headon Beds of Colwell Bay and by Nyst (1836 : 36) from the Tongrian of Klein Spauwen (Belgium) cannot be confirmed and are almost certainly incorrect. Bristow *et al.* (1889 : 289) erroneously state that Keeping & Tawney (1881) record this species from the Bracklesham Beds of the Isle of Wight. This record, in fact, is from the Brockenhurst Bed of the Headon Series (see 'Material Studied').

Giebel (1864 : 17, pl 1, fig 1) described and figured *Buccinum bullatum* Philippi from Latdorf. Von Koenen (1865 : 466) redetermined this as *Strepsidura deserta* (Solander) From the figure it is clear that Giebel's determination was right and von Koenen's was wrong. In his more authoritative later publication (1889 : 241) von Koenen does not record *P. deserta* from Latdorf.

### ***Pseudocominella armata*** (J. de C. Sowerby, 1850)

(Pl. 3, figs 1–8)

1835 *Buccinum fusiforme* Deshayes: 653.
1837 *Buccinum fusiforme* Deshayes; Deshayes, pl. 87, figs 15, 16, 17.
1850 *Buccinum fusiforme* Deshayes: d'Orbigny: 420.
1850 *Strepsidura armata* J. de C. Sowerby *in* Dixon: 104, 186, pl. 7, fig. 11.
1865 *Buccinum fusiopsis* Deshayes: 499.
1889 *Cominella deserta* (Solander) Cossmann: 136 (*pars*).
1891 *Strepsidura armata* J. de C. Sowerby; Newton: 165 (*pars*).
1901 *Cominella deserta* (Solander); Cossmann: 149, 150, (*pars*).
1911 *Cominella deserta* (Solander); Cossmann & Pissarro, pl. 37, fig. 178–1.
1948 *Cominella deserta* (Solander); Morellet, L. & J.: 30, 133, 179, 331, 343.
1963 *Cominella deserta* (Solander); Glibert: 67 (*pars*).

NEOTYPE (proposed herein). Middle Eocene, Auversian, exact horizon unknown, (probably Bed 19 (Brook Bed) of Fisher 1862 : 74) Upper Bracklesham Beds, Bracklesham Bay, Sussex, GG 19681/1 (*Ed*).

MATERIAL STUDIED. ENGLAND, All from Upper Bracklesham Beds, Auversian. Bracklesham Bay, GG 19681/2–4 (*Ed*) (probably same horizon as Neotype); G 8869/1–6 (*Ogle Colln.*); Bed 19 (Brook Bed) of Fisher (1862 : 74), *Sedg. Mus.* C 64860 (*Fisher Colln.*); G 75897, G 75998 (*E. M. Venables Colln.*). Brook, Hampshire GG 19683/1–4 (*Ed*); *Sedg. Mus.* C 67793. Huntingbridge, Hampshire, GG 19684 (*Ed*). Bramshaw, Hampshire, GG 19685/1–4 (*Ed*). 'Fossil bed' at Bramshaw of Fisher (1862 : 81, lines 2–4), 1 juvenile (*Cu*). FRANCE, Two separate samples in Deshayes

Colln., École des Mines, Paris (see p. 195). One labelled Le Fayel, Mary and Caumont, the other labelled Vendrest, Auvers and Acy, with no indication as to which shell comes from which locality. All these localities were quoted by Deshayes (1865 : 499), none of them were mentioned by him in his original description (1835 : 653–654).

Further occurrences. France, Lutetian:—Grignon (Deshayes, 1835 : 654), (Cossmann 1889 : 137). Auversian: Valmondois (Deshayes 1835 : 654) (1865 : 499); Le Guépelle (Deshayes, 1865 : 499); Bezu-le-Guery, Le Fayel (Glibert, 1963 : 67); Auvers (p. 133), Nanteuil-le Haudouin (p. 179), Acy (p. 331), Ru d'Alland valley (p. 343) Morellet (1948); Acy (Cossmann & Pissarro, 1911, pl. 37, fig. 178–1). Exact horizon unknown. Senlis (Deshayes, 1835 : 654).

Diagnosis. *Pseudocominella* with teleoconch of up to six whorls; mean spire angle between 60° and 65°; up to twenty-five collabral ribs per whorl on early part of teleoconch, reducing to about ten increasingly nodose ribs on each of the last two to three whorls; whorl profile convex on early whorls, shoulder becoming increasingly angular on later whorls; spiral sculpture of varying strength; margins of fasciole strongly ridged; fasciole very rugose; outer lip denticulate within in some individuals.

Description. All the specimens are damaged and those from the type locality are partly crushed. The protoconch (pl. 3, fig. 4) is typical for the genus and is fairly well-preserved on specimens from Brook and Bramshaw. It consists of about three apparently smooth naticoid whorls. The subsutural platform and close-set collabral ribbing first appear towards the end of the third whorl. On the first three or four whorls of the teleoconch the subsutural platform is bordered by a raised rim which eventually becomes obsolete, finally, on the body whorl the platform tends to be downward sloping. The early whorls of the teleoconch are broadest at the adapical suture and are evenly convex in profile except for a groove under the subsutural platform. In later whorls this groove develops into a broad concave ramp. The profile is further modified by the development of nodes at the shoulder, below which the whorl-sides are vertical.

The two strongest spiral ribs on the early teleoconch mark the edge of the subsutural platform and the shoulder. On later whorls there are normally two strong ribs in each of these positions. They are joined by others on the ramp itself and increase in number to between seven and fifteen on the ramp of the last whorl. The spiral sculpture differs considerably on specimens from different localities. The patterns of ribbing on the ramp of shells from Bracklesham Bay, Whitecliff Bay and Brook are similar; Bramshaw and Huntingbridge shells differ in having much stronger ribs which may be differentiated into those of primary and secondary strength. Below the shoulder on the peripheral region, up to ten weak spiral ribs may be seen with difficulty on the spire whorls of specimens from Bracklesham Bay. These usually die out on the body whorl of Bracklesham specimens (including the neotype) but always persist on specimens from other localities. The ribs are barely stronger on the Whitecliff Bay and Brook specimens. The Bramshaw and Huntingbridge shells have over forty considerably stronger and more clear-cut ribs of

both primary and secondary strength on the body whorl. The neck region of specimens from all localities bears between eleven and fifteen spiral ribs.

There are between twenty and twenty-five collabral ribs on each of the first two whorls of the teleoconch. These become more irregular in strength and spacing on the next whorls, reducing eventually in number to about nine evenly spaced nodes on the fifth and sixth whorl of the teleoconch. On the earlier whorls they are well-rounded in section, separated by rather broader, smoothly concave interspaces. They are moderately strong and of even strength below the shoulder; above it they markedly decrease in strength and are almost obsolete at the sub-sutural ramp. On the body whorl the collabral sculpture is confined to the area just above and below the shoulder. It consists of strong nodes or sometimes blunt spines. Six of the twelve specimens from the type locality have, on the last whorl, indications of a growth halt during which an aperture similar to the terminal one was developed. Here, the growth lines are more prominent, the outer lip was apparently slightly flared and parietal callus remains above the adapical suture of the previous whorl. One specimen has two such halts and on two of the larger shells these halts occur about 180° before the terminal aperture. Signs of preterminal apertures are common but much less prominent on specimens from other localities. The track of the fasciole is rather deeply grooved, and its bordering ridges, particularly the anterior, are strong. Growth rugae in this region are noticeably imbricate especially in the larger shells. The aperture is damaged in all specimens; none of those from the type locality and only one out of the four from Brook shows any indications of the outer lip being denticulate within. Internal ribs stretch back for about 45° within the aperture in specimens from other localities. In one specimen from Bramshaw these break down into numerous intermittent dashes as the aperture is approached.

| Dimensions. | 1 | 2 | 3 | 4 | 5 | 6 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|
| GG 19681/1 NT | 25·5 | 15·7 | 16± | 6 | 9 | 10 | — | 1·6 | 1·57 |
| GG 19681/2 | 22+ | — | 15·1 | 6 | 10 | 10 | — | — | 1·47 |
| GG 19681/3 | 22 | 13 | 12·9 | 6 | 9 | 12 | — | 1·69 | 1·70 |
| GG 19681/4 | 17+ | 11± | 10·3 | 6 | 8 | 10 | — | — | — |
| GG 19685/4 | 12 | 7 | 6·5 | 5+ | 13 | 18 | — | 1·71 | 1·84 |
| GG 19685/3 | 16 | 9·2 | 9·7 | 5+ | 12 | 19 | 12 | 1·74 | 1·65 |
| GG 19685/1 | 26·7 | 16·2 | 16·7 | 6+ | 9 | 9 | 15 | 1·65 | 1·60 |
| GG 19685/2 | 28+ | 16·5 | 17·7 | 6+ | 10 | 9 | some | 1·70 | 1·58 |
| GG 19684 | 15·5 | 9·3 | 9·3 | 6 | 9 | 12 | 13 | 1·67 | 1·67 |

(see p. 192 for key)

Remarks. The appearance and matrix of the neotype and associated specimens GG 19681/1–6 (*Ed*) matches that of the specimens listed which are known to come from the Bed 19 (The Brook Bed) at Bracklesham Bay.

All the French records of *'Cominella' deserta* are considered herein to be of *P. armata* (see pp. 192 and 194). Specimens of *Buccinum fusiopsis* in the Deshayes Collection (*EMP*) (no specimens from Deshayes original (1835 : 653–654) localities survive) and the specimen from Acy figured as *Cominella deserta* by Cossmann and Pissarro (1911, pl. 37, fig. 178–1) have strong sculpture very similar in character to

that of specimens from Bramshaw and Huntingbridge in the New Forest (Hampshire). The specimen which Cossmann figures (1901, pl. 6, fig. 4) as *Cominella deserta* is stated to be from Barton and the specific identification appears to be correct. All the English specimens of *P. armata* have stronger nodes at the periphery of the last whorl than any of the French specimens examined; the closest comparison is between them and the specimen figured from Huntingbridge (cf. pl. 3, figs 6 and 8). *P. deserta* always has a more rounded whorl profile and a narrower, more concave ramp. The only previous figure of an English specimen of the species is of the relatively smooth form originally described by Sowerby from Bracklesham Bay (1850, pl. 7, fig. 11). Without knowledge of the Bramshaw and Huntingbridge specimens, it is hardly surprising that French authorities considered their specimens either to be specifically distinct from *P. armata* or to be synonymous with *P. deserta*. The exposures at Bramshaw and Huntingbridge are slightly younger than the Brook Bed (Bed 19) of Brook and of Bracklesham Bay (Fisher, 1862 : 92–93; Curry 1958 : 70–71). It seems likely that *P. armata* gave rise to *P. deserta*. Changes include an increase in strength of spiral sculpture, an increase in the number of collabral ribs on the later whorls, gradual disappearance of peripheral nodes and the narrowing of the ramp.

Deshayes proposed the name *Buccinum fusiopsis* (1865 : 499) as his earlier name *B. fusiforme* (1835 : 653) was preoccupied (Borson, 1820 : 222). Sowerby's name (1850 : 104, 186) therefore stands. The surviving parts of both Dixon's and the Sowerby family's collections are housed in the British Museum (Natural History), but the whereabouts of this figured specimen is unknown. Comparisons with *P. deserta* and *P. solanderi* follow the description of the latter, whilst those with *P. bullata* (Philippi) and *P. semicostata* are discussed under the last named. The name *armata* has often been applied erroneously to *P. semicostata* (see its synonymy). The record from the Belgian Oligocene by Glibert & de Heinzelin (1954 : 367) of *Northia* (*Cominella*) *bullata* f. *armata* is of *P. bullata*.

### ***Pseudocominella semicostata*** sp. nov.

(Pl. 3, figs 9–10; Pl. 4, figs 1–3)

1864 *Strepsidura deserta* var. *armata* J. de C. Sowerby; von Koenen: 100.
1880 *Strepsidura* (*Buccinum*) *armata* J. de C. Sowerby; Judd: 154.
1880 *Strepsidura* (*Buccinum*) *semicostata* Edwards MS; Judd: 154 (*nom. nud.*).
1881 *Strepsidura* (*Buccinum*) *armata* J. de C. Sowerby: Keeping & Tawney: 111, 113, 116.
1881 *Strepsidura* (*Buccinum*) *semicostata* Edwards MS; Keeping & Tawney: 116 (*nom. nud.*).
1882 *Strepsidura armata* J. de C. Sowerby; Judd: 477.
1891 *Strepsidura armata* J. de C. Sowerby: Newton (*pars*): 165.
1891 *Strepsidura semicostata* Edwards MS; Newton: 165 (*nom. nud.*).
1901 *Strepsidura armata* J. de C. Sowerby; Cossmann: 133.
1901 *Strepsidura semicostata* Edwards MS; Cossmann: 133 (*nom. nud.*).
1902 *Strepsidura armata* J. de C. Sowerby; Reid: 40.
1915 *Strepsidura armata* J. de C. Sowerby; White: 44.
1926 *Melongena* (*Cornulina*) *minax* (Solander) Jackson: 360 (*pars*).
1926 *Strepsidura armata* J. de C. Sowerby; Jackson: 364.
1960 *Strepsidura armata* J. de C. Sowerby; Glibert: 9.

HOLOTYPE. Upper Eocene, Late Priabonian, Middle Headon Beds, Whitley Ridge, railway cutting, Brockenhurst, Hampshire GG 19687/1 (*Ed* ex *K*).

PARATYPES. All Upper Eocene, Late Priabonian, Middle Headon Beds. Whitley Ridge Railway cutting, Brockenhurst, Hampshire, GG 19687/2–3 (*Ed* ex *K*); *Sedg. Mus.* C 26453–8 (*K*). Victoria Tilery, Brockenhurst, (*S*). 'Brockenhurst', exact locality unknown, GG 19688/1–14 (*Ed*); GG 19689/1–2 (*StJB*); G 7760 (*Beckles Colln.*). Lyndhurst, Hampshire, GG 19690/1–4 (*Ed*). Royden, Hampshire GG 19686/1–9 (*Ed* ex *K*); *Sedg. Mus.* C 25070–90 (*K&T*). Brockenhurst Bed, Whitecliff Bay, I.O.W., GG 19692/1–5 (*Wr*); *Sedg. Mus.* C 29270–3 (*K&T*); *Sand. Mus.* 1930 (*J. F. Jackson*), recorded as *Melongena minax*. *?Venus Bed*, Colwell Bay, I.O.W., GG 19691 (*Ed*).

FURTHER OCCURRENCES. Unknown.

DIAGNOSIS. Stout *Pseudocominella* with between six and seven whorls of teleoconch; mean spiral angle increasing from 60° to 80° with growth; ramp broad; shoulder angular except for early teleoconch, low, at or below mid-height of spire whorls; about twenty-one collabral ribs on early part of teleoconch reducing to nine or ten very nodose ribs on last three whorls; aperture broad; fasciole bordered by strong ridges; fasciole very rugose; outer lip denticulate within in some specimens.

DESCRIPTION. The protoconch is decorticated or missing in all specimens; its gross size and shape is similar to that of *P. deserta* (Solander). The first two to three whorls of the teleoconch are broadest at the adapical suture and are convex in profile except for a subsutural constriction which rapidly grows into a broad concave ramp. The profile becomes strongly carinate on the fifth and sixth whorl of the teleoconch, with the periphery coinciding with the shoulder. The subsutural platform is horizontal, on later whorls it becomes wavy under the influence of the axial nodes. At the earliest point in the development of the teleoconch at which it is possible to determine detail there are three prominent spiral ribs, and the whorl profile is naticoid. During this whorl, two new ribs develop between the two most adapical. The opisthocyrt collabral costae are of similar strength and form a reticulate pattern with slight nodes at the intersections; they do not extend on to the subsutural platform which first develops on this whorl and is bordered by a spiral rib. The following whorl (third of the teleoconch) is similar except for the broadening of the subsutural ramp which lacks spiral ribbing. The shoulder is marked by the second most adapical spiral rib. The reticulate pattern is made of increasingly spirally-elongate rectangles. On the fourth teleoconch whorl the increasing strength of the collabral ribs compared with the spiral ribs becomes noticeable; within the next whorl or so this leads to the loss of the reticulate appearance. The ramp gradually becomes concave and bears two new spiral ribs of secondary strength. The edge of the subsutural platform is marked by two strong spiral ribs and another pair lies on the shoulder. Between the fifth and seventh teleoconch whorls seven to ten spiral ribs are developed on the ramp. Apart from those on the shoulder and bordering the subsutural platform these are seldom of greater strength than those on earlier whorls and are often difficult to follow even on

well-preserved shells. On immature specimens with a teleoconch of four whorls, there are on the body whorl between eighteen and twenty spiral ribs of varying strength below the shoulder, seven or eight of these being on the neck and rather stronger. The full adult number of spiral ribs, about twenty-nine in all, of which fourteen are on the neck, is reached by the sixth teleoconch whorl. There are between eighteen and twenty-one collabral ribs on the first four teleoconch whorls; these die away below the peripheral region of the body whorl even in juvenile shells. On the next whorl these weaken on the ramp and become increasingly nodose at the shoulder and grow further apart. From here on nine or ten axial nodes or spines occur on each whorl. The fasciole is strongly ridged and is very rugose in large specimens. Specimens showing ribs on the inside of the outer lip are very rare.

| Dimensions. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GG 19687/1 HT | | | | | | | | | | | |
| estimated | 27·0 | — | — | — | — | — | — | — | — | 1·86 | 1·52 |
| actual | 26·1 | 14·5 | 17·8 | 6 | 13 | 12 | — | — | 16 | — | — |
| GG 19686/2 PT | 20·3 | 12·8 | 13·7 | 5½ | 9 | 11 | 36 | 12 | 10 | 1·58 | 1·48 |
| GG 19686/3 PT | 13·8 | 8·5 | 8·5 | 5 | 12 | 21 | 33 | 10 | 0 | 1·62 | 1·62 |
| GG 19686/4 PT | 8·7 | 5·5 | 5·2 | 4½ | 16 | 20 | 23 | 7 | 11 | 1·58 | 1·67 |
| GG 19686/5 PT | 7·4 | 4·7 | 4·3 | 4 | — | 17 | 28 | 5 | 0 | 1·57 | 1·72 |
| GG 19688/1 PT | 32+ | 19·5 | 21·1 | 6½ | 8 | 12 | 42 | — | 0 | — | — |

(see p. 192 for key)

Remarks. Edwards gave the manuscript name *Strepsidura semicostata* to his single specimen from Colwell Bay (GG 19691). This was so badly worn that he failed to recognize that it was conspecific with numerous other specimens (listed here) which he identified as *S. armata*. *P. semicostata* differs from *P. armata* in being relatively stouter, having a broader, less sloping ramp, more prominent axial nodes, and a lower shoulder. It has also been confused by von Koenen (1864 : 100) and by Judd (1880 : 154) with *P. bullata* (Philippi) which may be easily distinguished by its much weaker collabral sculpture on the early teleoconch; strong axial ribbing and nodes are normally confined to its body whorl.

### ***Pseudocominella solanderi*** (Cossmann, 1889)

(Pl. 2, figs 1–8)

1766 *Buccinum desertum* Solander: 13 (*pars*), pl. 1, fig. 18 (*non* figs 15, 19).
1887 *Cominella solandri* Edwards; Keeping: 71 (*nom. nud.*).
1888 *Buccinum solandri* Gardner, Keeping & Monckton: 620 (*nom. nud.*).
1888 *Buccinum* sp. nov.; Gardner, Keeping & Monckton: 627.
1889 *Cominella solandri* Edwards; Bristow: 120, 290 (*nom. nud.*).
1889 *Cominella deserta* (Solander) var. *solanderi* Edwards; Cossmann: 137.
1901 *Cominella* (*Buccinum*) *solanderi* (Edwards) Cossmann: 150.
1926 *Cominella solandri* Edwards MS; Jackson: 356.
1933 *Cominella* sp.; Burton: 156.

NEOTYPE (selected herein). Upper Eocene, early Priabonian, Lower Barton Beds, Horizon A3, coastal section between Highcliffe and Barton, Hampshire, GG 19693/1 (*Ho*).

MATERIAL STUDIED. Same locality, Lower Barton Beds, horizon unspecified GG 19696/1–20 (*Ed*); 19697/1–10 (*Wr*). Horizon A2, GG 19703 (*Ru*). Horizon A2 (near top) GG 19698/1–20 (*Nu*). Horizon A3, GG 19699/1–50 (*S*); GG 19700/1–3 (*StJB*); GG 19693/2–3 (*Ho*); GG 19694/1–18 (*Le*); GG 19695/1–3 (*S*); (*Cu*); (*Je*). Horizon B, 2 specimens (*Ru*).

Alum Bay, I.O.W., Barton Beds, horizon unknown, *Sedg. Mus.* C 59712–4; (10 specimens) *Sand. Mus.* 4720. Lower Barton Beds (near top) GG 19731/1–8 (*Wr*); (2 specimens) *Sand. Mus.* 1084 (*J. F. Jackson Colln.*). Whitecliff Bay, I.O.W. Barton Beds, lowest 13 inches with *Nummulites elegans*, *Sedg. Mus.* C 64098 (*K*).

FURTHER OCCURRENCES. Lower Barton Beds, Barton-on-Sea, as *Cominella* sp., horizons A3 and B (Burton, 1933 : 156).

DIAGNOSIS. Moderate sized, fairly elongate *Pseudocominella* with a marked horizontal and undercut subsutural platform; mean spire angle between 50° and 60°; collabral ribs present only on early whorls of neoconch; spiral sculpture of close-spaced low ribs; outer lip ribbed internally.

DESCRIPTION. The protoconch is about 1·2 mm high and broad. Its first half whorl is minute; it seems to be disjunct with a semi-erect tip, but this appearance is certainly due to weathering. It is followed by two and a half smooth naticoid whorls. It seems very unlikely that the transition to the teleoconch was abrupt; orthocline collabral ribs of increasing strength occur, these soon become nodose and are joined by spiral ribbing within a quarter whorl. Most adult specimens are badly worn; the sculpture of the body whorl is abraded and the early whorls either decorticated or even missing, the main exceptions are immature specimens under 8 mm high. Teleoconchs of shells 20 mm high would have been of six whorls. Each whorl is enveloped by the succeeding one just below the periphery. The first two-and-a-half to three teleoconch whorls bear twelve, increasing to sixteen rather angular, orthocline, collabral ribs. These die out by a shell height of between 6 and 8 mm, except on a very few of the specimens seen, where they persist above the periphery sometimes until full growth is reached. On succeeding whorls the only collabral sculptural elements are rugae which are distinctly stronger than the growth lines seen on well preserved shells. Spiral ribbing and the subsutural platform appear about a quarter whorl after the first collabral ribs. The subsutural platform, which reaches a width of 1 mm on the last whorl of large shells is normally horizontal but may slope either upwards or downwards away from the suture. Another fairly strong spiral rib marks the shoulder, which is nodose and carinate for the first two or three whorls of the teleconch. Within the next two whorls these are joined by a weaker spiral rib on the concavely-sloped sutural ramp and three or four more between the shoulder and the suture below. By the fifth teleoconch whorl the latter have increased in number to eight or nine. Two spiral ribs of lower strength commonly occur on the sutural ramp. On the last whorl other weak ribs are sometimes irregularly disposed, mainly above the periphery. The

number of spiral ribs on the last whorl increases with size (see table), most adult shells having between thirty-eight and forty ribs of varying strength. The nine or ten on the neck region are the strongest, apart from the primary ribs on the shoulder and on the edge of the subsutural platform. The spiral ribs are about the same width as the interspaces except on the neck region where they are more widely spaced. In section they are usually gently convex and often almost flat-topped. The inner surface of the outer lip bears ribs which do not correspond with the external ones. They stretch back inside the aperture for nearly a quarter whorl in large individuals, less so in small ones and are resorbed as the shell grows. The number of internal ribs is about half that found on the outer surface and is dependent on size. Two spiral colour-bands may be seen on the neotype, one, about a millimetre broad, on the ramp with a narrower one just below the shoulder, other specimens also show this phenomenon (pl. 2, figs 4, 6, 7, 9).

| Dimensions. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GG 19693/1 NT | 14·7 | 7·6 | 7·8 | 5½ | 0 | 0 | 28 | 10 | 18 | 1·93 | 1·89 |
| GG 19695/3 | 5·2 | 3·0 | 2·9 | 3 | 19 | 14 | 17 | 5 | 13 | 1·73 | 1·79 |
| GG 19694/17 | 6·2 | 3·5 | 3·5 | 4 | 9 | 16 | 24 | 7 | 11 | 1·77 | 1·77 |
| GG 19693/2 | 8·6 | 4·7 | 4·5 | 4½ | 0 | 14 | 25 | 10 | 11 | 1·83 | 1·91 |
| GG 19694/14 | 10·8 | 6·1 | 6·5 | 5 | 6 | 15 | 32+ | 11 | 14 | 1·72 | 1·66 |
| GG 19694/10 | 12·6 | 7·4 | 6·8 | 5 | 0 | 0 | 38+ | 11 | 17 | 1·70 | 1·61 |
| GG 19694/6 | 14·6 | 8·2 | 8·2 | 5 | 4 | 15 | 41 | 14 | 17 | 1·78 | 1·78 |
| GG 19694/5 | 17·8 | 9·5 | 9·2 | 5½ | 0 | 0 | 35 | 19 | 19 | 1·87 | 1·93 |
| GG 19694/1 | 20·0 | 12·0 | 11·1 | 6 | 0 | 15 | 41 | 16 | 22 | 1·67 | 1·80 |
| GG 19700/3 | 25·5 | 13·5 | 13·8 | — | 0 | — | — | — | 20 | 1·89 | 1·85 |

(see p. 192 for key)

Remarks. Cossmann (1889 : 137) in discussing *P. deserta* wrote 'les figures qu'en donne Brander sont très exactes, sauf la figure 18, qui représente une variété pour laquelle a été proposé le nom *Solanderi*, Edw.'. The specimen figured by Solander is lost. None of the specimens GG 19696/1–20 in the Edwards Collection, which are labelled as *solandri*, have been chosen as neotype as they are all badly worn. In the circumstances it seems justifiable to select a neotype from better preserved material whose horizon is known more precisely.

This species is unknown except from the Lower Barton Beds. One sample, GG 19701/1–4 (*Wr*) was labelled as being from the Middle Barton Beds. Examination by several workers suggested that the specimens did in fact, come from the Lower Barton Beds. Moreover glue was present on the specimens, unlike others in Wrigley's Collection, suggesting that he might have acquired the specimens from an old collection and had assumed that any information with the specimens was correct. Another specimen, GG 19702 (*Wr*) was found in the same box as three specimens of *P. deserta*, GG 19678/1–3 (*Wr*) from the Upper Barton *Chama* Bed (Bed H). Again, examination by several workers showed that the preservation and matrix of the specimen of *P. solanderi* was not the same as that of its companions and that it was almost certainly from the Lower Barton Beds.

This species is among the twenty most common prosobranchs in horizon A3, of the Lower Barton Beds where *P. deserta* is extremely rare. The latter species,

however, is more common in the Middle and Upper Barton Beds in which *P. solanderi* is unknown. Both species usually attain a height of 20 mm in Bed A3 of the Lower Barton Beds. In the Middle Barton Beds, *P. deserta* often exceeds 30 mm in height. This increase in size corresponds with almost an extra whorl (making a total of seven for the teleoconch).

*P. deserta* is relatively broader and its sculpture is stronger. The spiral sculpture is the only completely consistent difference between the two species. In *P. deserta* the interspaces are wider and the ribs are usually alternately of primary and secondary strength. A small proportion of specimens of one species may show one or more of the features listed below which normally distinguish it from the other. In *P. deserta* the collabral ribs tend to increase in strength with size, whilst they become obsolete by the third whorl in all but a few *P. solanderi*. The subsutural platform is broader and more strongly grooved below in *P. deserta* and the carina on the shoulder persists to adulthood in most individuals.

In all four of the British species of *Pseudocominella*, the early teleoconch has such similar sculpture, shape and rate of whorl expansion that juveniles are difficult to tell apart. The nodiferous, carinate, shoulder of this stage is most noticeable and of shortest duration in *P. solanderi* which is the least strongly sculptured when adult.

## ***DESORINASSA*** gen. nov.

(Pl. 4, figs 4–9, Pl. 5, figs 1–5)

Type species. *Buccinum desori* Deshayes, 1865.

Diagnosis. Agrees with *Pseudocominella* except in the following respects: subsutural platform not always developed; sculpture very weak; columella curved to the right above columellar plait; growth lines of fasciole not particularly rugose and not very sinuous; ridge above fasciole not strong; outer lip smooth within.

Other species assigned. **Buccinum acies* Watelet, 1853 (*IRScNB*); ***Cominella bonnecarrei* Furon 1948; **Buccinum latum* Deshayes, 1865 (*EMP*); *Buccinum ovatum* Deshayes 1835 (*EMP, MNP*). ***Cominella supracostata* Traub, 1938; **Desorinassa williamsi* sp. nov. (see footnote for explanation).

Geological range. Palaeocene (Thanetian) to Lower Eocene (Cuisian).

Remarks. *Desorinassa* may be distinguished from *Pseudocominella* by its curved columella and its weaker sculpture, in particular the almost complete lack of collabral elements. The fasciole is more like that of *Keepingia* and *Thanetinassa*.

The specimens of *Buccinum latum* Deshayes, (*Deshayes Colln., EMP*) figured herein as pl. 4, fig. 8 and pl. 4, fig. 9 are selected respectively as Lectotype, and Paralectotype of this species. They are labelled as being from Abbecourt and Bracheux with no indication as to which specimen comes from which locality. These are the only localities quoted by Deshayes in his original description (1865 :

In these lists * denotes species in which the protoconch has not been studied, ** denotes that no specimens have been examined.

501). It would appear that his illustration of the apertural view of the species (1866, pl. 93, fig. 27) is composed of the outline of the lectotype upon which has been superimposed the better preserved outer lip and stronger columellar and parietal callus of the paralectotype.

### *Desorinassa desori* (Deshayes, 1865)

(Pl. 4, figs 4–6)

1865 *Buccinum desori* Deshayes; 501.
1866 *Buccinum desori* Deshayes; Deshayes, pl. 93, figs 16, 17.
1889 *Cominella desori* (Deshayes) Cossmann: 137.
1901 *Cominella desori* (Deshayes); Cossmann: 150.
1911 *Cominella desori* (Deshayes); Cossmann & Pissaro, pl. 37, fig. 178–3.
1934 *Cominella desori* (Deshayes); Cooper: 8.
1936 *Cominella desori* (Deshayes); Farchad: 22.
1963 *Cominella desori* (Deshayes); Glibert: 67.

Material studied. England, Palaeocene, Thanetian, Thanet Sand, Reculver, Kent GG 19704 (*Wr*) (see remarks p. 203). France, Thanetian, Jonchery-sur-Vesle, France, GG 19705/1–3 (*Wr*); G 19438/1, 2 (*L. Staadt*).

Further occurrences. England, Thanetian, Bishopstone, near Reculver, (Cooper, 1934 : 8) (see remarks, p. 203). France, 'Sables inferieurs' (= Thanetian), Abbecourt; Châlons-sur-Vesle; Jonchery; Saint Martin-aux-Bois (Deshayes, 1865 : 501). Châlons; Chenay; Jonchery; Noailles (Glibert 1963 : 67). Bracheux, near Beauvais (Farchad, 1926 : 22).

Diagnosis. Moderately large, stout, almost smooth *Desorinassa* with broad, sloping subsutural platform; mean spire angle about 60°; sutural slope reversed just prior to adult aperture; ridge on adapical side of fasciole very weak; outer lip not striate within.

Description. The protoconch is worn but appears to have been similar to that of *Pseudocominella*, consisting of about three smooth, naticoid whorls; initially it may have been somewhat flattened. The teleoconch has up to six whorls which are convex-sided with the periphery lying just above the suture. A cord may be seen below the suture on the first whorl of the teleoconch. The material is not well enough preserved to show the development of the subsutural platform. It is first recognizable by the third whorl of the teleoconch where either two (or in some specimens three) spiral ribs, situated high on the ramp near the suture, form an angulation in the whorl profile. Subsequently the platform becomes flatter, though the slope is never less than 45°. It reaches a breadth of nearly 1·5 mm. No groove is developed but the profile is slightly concave just below the platform. Spiral sculpture is poorly developed, there are two or three weak grooves just below the subsutural platform and a mixture of about fifteen weak grooves and step-like ribs on the neck region of the body whorl. Collabral sculpture is absent except for growth rugae, these are strongest away from the periphery, becoming quite noticeable on and just below the subsutural platform and to a lesser extent on the neck

region. The ridge marking the adapical margin of the fasciole can hardly be distinguished in smaller specimens. No ribbing has been seen inside the outer lip. The sutural slope becomes reversed immediately prior to the final aperture.

| Dimensions. | 1 | 2 | 3 | 4 | 7 | 10 | 11 |
|---|---|---|---|---|---|---|---|
| GG 19704 | 22+ | 11+ | 14+ | — | — | — | — |
| GG 19705/3 | 11·3 | 6·5 | 6·3 | 4+ | 12+ | 1·74 | 1·79 |
| GG 19705/1 | 13·3 | 8·2 | 7·9 | 4½ | 17+ | 1·62 | 1·68 |
| G 19438/2 | 16·5 | 9·9 | 9·7 | — | — | 1·67 | 1·70 |
| G 19438/1 | 17·6 | 10·0 | 10·6 | 5+ | 18+ | 1·76 | 1·66 |

(see p. 192 for explanation)

Remarks. *D. desori* differs from *D. acies* (Watelet) (pl. 5 fig. 5) and *D. ovata* (Deshayes) (pl. 5, fig. 4) in being larger, having a subsutural platform and lacking regular spiral sculpture. A comparison with *D. williamsi* is given under the latter. The single English specimen of *D. desori* seen is badly damaged but agrees in all essential respects with the French specimens.

It is thought that Wrigley acquired many of the more interesting specimens of J. E. Cooper's collection and GG 19704 was found in a box which was probably made by Cooper. It is therefore possible that this specimen is that listed by Cooper (1934 : 8) and that only one specimen has so far been discovered in English rocks. However, A. J. Rundle (personal communication) after examining its matrix reports that it is a silicified specimen from the *Corbula* bed in the cliff at Reculver and not from the *morrisi* bed, as listed by Cooper.

### ***Desorinassa williamsi*** sp. nov.

(Pl. 5, figs 1–3)

Holotype. Palaeocene, Ypresian, Bognor Rock, foreshore at Bognor, Sussex, GG 19706 (*B. A. Williams Colln.*).

Paratypes. Some horizon and locality, GG 19707, (*Rev. A. Fuller Colln.*), and two internal moulds GG 19708/1–2 (*history unrecorded*).

Further material and records. Unknown.

Diagnosis. Large, stout, almost smooth *Desorinassa*; mean spire angle of about 60°; subsutural platform lacking; whorl profile convex; interior of outer lip not denticulate.

Description. The protoconch is unknown. Four whorls of the teleoconch survive; at least one or two earlier whorls are missing in all specimens. The whorls, which are broadest at the abapical suture, are convex except where recurved at the adapical margin to form an adpressed or almost flush suture. Spiral sculptural elements are lacking except for between six and eight weak ridges on the neck of the body whorl. Irregularly spaced collabral growth rugae of varying strength are developed. These, though weak, are distinctly stronger than growth lines. No ribs are present on the inner surface of the outer lip. Both internal moulds have a collabral groove about a quarter whorl before the aperture.

| Dimensions. | 1 | 2 | 3 | 7 | 10 | 11 |
|---|---|---|---|---|---|---|
| GG 19706 HT | 27·8+ | 17·3 | 17·0 | 8+ | — | — |
| estimated | 29 | — | — | — | 1·68 | 1·71 |
| GG 19707 PT | 27·2+ | 17·2 | 17·9 | 5+ | — | — |
| estimated | 30 | — | — | — | 1·74 | 1·67 |

(see p. 192 for key)

Remarks. This species may be easily distinguished from *D. desori* which is smaller, and has a broad, sloping, subsutural platform with spiral ribbing on and near it. Two Cuisian species from the Paris Basin, *D. ovata* (Deshayes) (pl. 5, fig. 5) and *D. acies* (Watelet) (pl. 5, fig. 6) are much smaller than *D. williamsi* and possess fine spiral ribbing. The former is of a similar shape to *D. williamsi* but the latter is distinctly narrower.

## *WHITECLIFFIA* gen. nov.

(Pl. 5, figs 6–12; Pl. 6)

Type species. *Buccinum suturosum* Nyst, 1836.

Diagnosis. Differs from *Pseudocominella* only in the following respects: height less than 20 mm; protoconch of one and half whorls, initially deviated and bulbous; suture either weakly canaliculate or with narrow, flat, subsutural platform; no shoulder developed; collabral sculpture either absent or of weak grooves or ribs; columellar and parietal callus distinctly raised above general level of shell surface; fasciole similar to that of *Pseudocominella* but ridges and growth lines less prominent; outer lip seldom ribbed within.

Other species assigned. *Whitecliffia tumida* sp. nov.

Geological range. Upper Eocene (Late Priabonian) to Middle Oligocene (Rupelian).

Remarks. This genus seems likely to be an offshoot of *Pseudocominella*. It may readily be distinguished by its protoconch and by the relative smoothness of the teleoconch.

### *Whitecliffia suturosa* (Nyst, 1836)

(Pl. 5, figs 6–11; Pl. 6, figs 1–4)

1836 *Buccinum suturosum* Nyst: 36, pl. 3, fig. 96.
1843 *Buccinum suturosum* Nyst; Nyst: pl. 43, fig. 16.
1845 *Buccinum suturosum* Nyst; Nyst: 579.
1867 *Buccinum suturosum* Nyst; von Koenen: 83, pl. 6 (1), fig. 3a, b, c.
1880 *Cominella* (*Buccinum*) *ventricosa* Edwards MS; Judd: 154.
1880 *Strepsidura suturosa* (Nyst) Bosquet: 467.
1881 *Cominella* (*Buccinum*) *ventricosa* Edwards MS; Keeping & Tawney: 116.
1886 *Strepsidura suturosa* (Bosquet); Vincent: 7.
1889 *Buccinum* (*Cominella*) *suturosum* Nyst; von Koenen: 242, pl. 21, figs 10a, b, c, 11a, b.
1901 *Cominella suturosum* (Nyst); Cossmann: 150.

1943 *Northia* (*Cominella*) *suturosa* (Nyst) Albrecht & Valk: 62, pl. 5, figs 140, 141.
1954 *Northia* (*Cominella*) *suturosa* (Nyst); Glibert & de Heinzelin: 367, 382, 392, 393, pl. 7, figs 4a, b.
1954 *Babylonia* (*Peridipsaccus*) *archambaulti* Meunier; Glibert & de Heinzelin: 368, 382, pl. 7, fig. 6.
1963 *Cominella suturosa* (Nyst); Glibert: 68.

LECTOTYPE. Middle Oligocene, Lower Rupelian, *Callista kickxi* horizon; *IRScNB* IG 3862, Klein Spauwen, Belgium (selected Glibert, 1963 : 68, figured Glibert, & de Heinzelin 1954, pl. 7, fig. 4b).

PARALECTOTYPE. Same details, *IRScNB* IG 3863, (figured Glibert & de Heinzelin, 1954, pl. 7, fig. 4a).

MATERIAL STUDIED. ENGLAND, Upper Eocene, late Priabonian, Middle Headon Beds, Royden, GG 19717 (*Ed*). Brockenhurst Bed, Whitecliff Bay, I.O.W., GG 19718 (*Wr*); (*Cu*). GERMANY, Lower Oligocene, Lattorfian, Latdorf, GG 19719/1–2 (*Ed*); GG 19720/1–2 (history unknown). BELGIUM, Lower Oligocene, Lattorfian (= Lower Tongrian), Grimmertingen *IRScNB* sample IG 5002 (*de Looz*). Middle Oligocene, Lower Rupelian, Klein Spauwen, GG 19721 (*de Koninck*). Berg, *IRScNB* sample IG 4285 (*Bosquet*).

FURTHER OCCURRENCES. HOLLAND, Lower and Middle Oligocene, South Limburg, in mine shafts (Albrecht & Valk, 1943 : 62). GERMANY, Middle Oligocene, Rupelian, Stettin Sands, Magdeburg, (von Koenen, 1889 : 242).

DIAGNOSIS. *Whitecliffia* with canaliculate suture; mean spire angle between 43° and 80°; whorls evenly convex with no shoulder developed; sculpture absent except for occasional weak spiral grooving; outer lip denticulate within.

DESCRIPTION. All the Belgian specimens and Wrigley's specimen from Whitecliff Bay are too badly worn to show sculptural details. The description is based mainly on the shells from Royden (GG 19717), Latdorf (GG 19719–20) and a specimen from Whitecliff Bay (*Cu*).

The mean spire angles of the lectotype, paralectotype and GG 19721 from Klein Spauwen are all under 50°. The spires of several specimens from Berg are also more acute than average. The English, Grimmertingen and Latdorf specimens are normally more tumid with the spire angle between 50° and 55°. The appearance of the suture is so considerably changed by wear, that this feature cannot be reliably used as a taxonomic feature. The better-preserved English and German specimens as well as most of the Belgian specimens have a narrow canaliculate suture and no subsutural ramp. Many of the Grimmertingen specimens, however, seem to have a fairly broad ramp and a less incised suture. In most specimens the sutures are not channelled for the first three or four whorls.

Below the suture the whorl profile is rather gently convex, and its periphery coincides with the abapical suture in most specimens. In shells with relatively acute spires, however, whorls are enveloped well below the periphery. About half the specimens have a relatively strong pad of callus in the parietal and columellar region which stands out above the rest of the shell-surface. The fasciole is not

very rugose but the ridges on either side are fairly sharp when unworn. Only one specimen, the largest in sample *IRScNB* IG 5002 from Grimmertingen, has ribbing on the inner surface of its outer lip; this feature is also shown in one of von Koenen's figures (1889, pl. 21, fig. 10b). All the spire whorls of GG 19717 bear weak spiral grooves; eight may be counted on the penultimate whorl, but they become obsolete on the body whorl, which is smooth except for ten ribs on the neck. On another larger specimen (*Cu*), spiral grooves which are too poorly preserved to count, are present on the fourth and fifth whorls whilst the last two are smooth. GG 19719/1 and GG 19720/1, from Latdorf, however, have twelve grooves on the penultimate whorl, twenty-four on the body whorl and thirteen ribs on the neck below. Another specimen from Latdorf GG 19719/2 whose surface is also well preserved shows traces of spiral sculpture only on the neck.

Grimmertingen specimens are remarkable in having two or three relatively strong grooves just below the subsutural platform; below this weaker grooves may sometimes be distinguished. All other Belgian specimens seen from Berg and Klein Spauwen lack this grooving. No specimens show any trace of collabral sculpture other than growth lines.

| Dimensions. | | 1 | 2 | 3 | 10 | 11 |
|---|---|---|---|---|---|---|
| GG 19717 | actual | 14·5 | 8·3 | 8·6 | — | — |
| | estimated | 15·5 | — | — | 1·87 | 1·80 |
| GG 19720/1 | | 16·1 | 9·1 | 9·1 | 1·77 | 1·77 |
| GG 19720/2 | | 16·9 | 10·0 | 8·9 | 1·69 | 1·90 |
| GG 19721 | actual | 16·8 | 9·2 | 8·6 | — | — |
| | estimated | 17·5 | — | — | 1·90 | 2·03 |
| GG 19719/2 | | 18·8 | 10·1 | 9·0 | 1·88 | 2·09 |

(see p. 192 for key)

Remarks. GG 19717 from Royden was labelled as *Cominella ventricosa* Edwards MS by Edwards; Keeping & Tawney's (1881 : 116) record is of this specimen. Judd's list (1880 : 154) was also compiled from the Edwards Collection, so his record of *C. ventricosa* from Colwell Bay, not Royden, is almost certainly a clerical error. Von Koenen (1867 : 83; 1889 : 242) quotes Royden as a locality. It therefore seems quite likely that he also examined this specimen, recognizing it to belong to *W. suturosa*. Grimmertingen specimens seem to represent a fairly marked variety, distinguished by the strength of the spiral grooving and by the usually less acute spire. A damaged specimen, *IRScNB* figd. spec. no. 4070 I.S.T. from Grimmertingen (pl. 5, figs 8a, b) identified as *Babylonia* (*Peridipsaccus*) *archambaulti* (Meunier) by Glibert & de Heinzelin (1954 : 368, 382, pl. 7, fig. 6) is definitely a *Whitecliffia* and may be an exceptionally large, broad example of the present species with a spiral angle of 80°.

### ***Whitecliffia tumida*** sp. nov.

(Pl. 6, figs 5–10)

Holotype. Upper Eocene, Late Priabonian, Middle Headon Beds (*Venus* Bed), Whitecliff Bay, I.O.W. GG 19722/1 (*Cu*).

Paratypes. Same locality and horizon, GG 19722/2–7 (*Cu*); GG 19724 (*Cu*); GG 19723/1–3 (*Wr*); *Sedg. Mus.* C 29305 (*K&T*); (*Cu*); (*S*); GG 19756/1–3 (*S*) from Bed O of Stinton (1971 : 405).

Further occurrences. Unknown.

Diagnosis. Broad *Whitecliffia* with teleoconch of four or five whorls; mean spire angle of about 65°; whorl profile strongly convex; last whorl often rather swollen; collabral sculpture normally of up to sixteen strong, rather angular, costae which becomes less frequent and either die out or are replaced by broad flexures on pre-penultimate or penultimate whorl; spirally multistriate; subsutural collar obsolete; suture becoming slightly canaliculate on last whorl or so; outer lip rarely internally ribbed.

Description. None of the specimens examined is complete, and the form of the aperture is seen clearly only in one paratype. Whorls are enveloped just below the periphery. The whorl profile is more strongly convex in the early whorls before the collabral ribbing dies away. The whorl profile is almost horizontal at the adapical suture, and usually becomes grooved by the third or fourth whorl. The subsutural platform reaches a maximum width of 0·5 mm but seldom exceeds 0·3 mm wide; it is not separated from the rest of the whorl-side by a rib. The teleoconch starts with numerous weak, slightly opisthocline, collabral ribs. In the next quarter whorl these increase in strength and gradually adopt the orthocline attitude of the collabral ribs of the later teleoconch. There are normally about sixteen rather prominent, angular, collabral ribs on the first whorls of the teleoconch. They are weakest just below the suture and are of maximum strength from the shoulder to the adapical suture. On the third teleoconch whorl they weaken considerably; they may be just discerned on the fourth as faint flexures, which, on the body whorl, can be seen to die away below the periphery. GG 19724 is unusual. On the second whorl of its teleoconch about ten slight collabral crenulations occur for nearly half a whorl. This is strongly reminiscent of the start of collabral ribbing in other specimens, but dies away instead of developing further. On this specimen no other collabral sculptural elements exist except for growth lines. In the other specimens the spiral sculpture is first noticed within half a whorl of the collabral sculpture appearing. It consists of between six and ten irregularly spaced bands. Usually they can be seen to be ribs separated by interspaces wider than themselves. Often, however, and particularly on the last whorl, this separation is reduced and the shell becomes spirally multi-grooved. Bands of secondary strength may sometimes be seen. Spiral sculpture is either weak or absent from the periphery of the body whorl. Between seven and ten fairly prominent cords are present on the neck region. Internal ribbing of the outer lip is seen clearly only on one specimen (*Cu*) which has fifteen ribs extending back from the aperture for at least 45°. Irregular collabral colour bands up to about 1 mm broad separated by gaps of similar size may be seen on the last whorl of GG 19722/3 and one specimen (*Cu*); neither of these specimens shows spiral colour banding. GG 19722/6, however, shows spiral but not collabral colour banding. There is a dark band about 0·5 mm wide on the subsutural platform

with a slightly narrower band just below the platform, below this there are indications of two more narrower bands well above the periphery.

| Dimensions. | 1 | 2 | 3 | 8 | 10 | 11 |
|---|---|---|---|---|---|---|
| GG 19722/1 HT | 12·9 | 8·0 | 7·7 | 9+ | 1·61 | 1·67 |
| GG 19722/2 PT | 5·0 | 3·2 | 3·1 | 6+ | 1·56 | 1·61 |
| GG 19722/4 PT | 6·7 | 4·0 | 3·9 | 8+ | 1·67 | 1·72 |
| GG 19722/5 PT | 7·5 | 4·7 | 4·0 | 9+ | 1·60 | 1·88 |
| GG 19722/7 PT | 10·2 | 6·4 | 6·9 | 9+ | 1·59 | 1·73 |

(see p. 192 for key)

Remarks. This species closely resembles *W. suturosa* in shape and size. In the latter, collabral sculpture is almost non-existent, spiral sculpture though similar is weaker, and grooving of the suture occurs earlier and is more noticeable. As indicated, GG 19724 has unusual sculpture. It seems advisable, however, not to describe a separate species on the basis of a single specimen.

## *COLWELLIA* gen. nov.

(Pl. 7)

Type species. *Cominella flexuosa* Edwards *in* Lowry, Etheridge and Edwards, 1866.

Diagnosis. Agrees with *Pseudocominella* except in the following respects: seldom exceeds 20 mm height; protoconch of about two and a half smooth whorls, small, about 1 mm high, initially slightly flattened, first whorl very small; teleoconch sculpture developing gradually with collabral sculpture developing first; teleoconch with spiral and collabral sculpture of varying strength; subsutural platform either poorly developed or absent; growth lines of fasciole broadly sinuous as in *Desorinassa*; outer lip often denticulate within.

Other species assigned. *Nassa antiquata* Gabb, 1864 (pl. 7, fig. 11) *Buccinum auversiense* Deshayes, 1865 (pl. 7, figs 6, 7); *Ancillaria bretzi*, Weaver, 1912 (pl. 7, figs 8, 9); **Nassa cretacea*, Gabb, 1864; **Molopophorus tejonensis* Dickerson, 1915). (See p. 201 for explanation).

Geological range. Middle Eocene (Auversian) to Upper Eocene (late Priabonian), Europe. Middle Eocene (Domengine Formation, California and Umpqua Formation, Oregon) to Upper Eocene (Cowlitz Formation, Washington and Tejon Formation, California), U.S.A.

Remarks. The growth lines of the species assigned above to *Colwellia* are of the type found in *Pseudocominella* and all the other new genera described herein: they are approximately orthocline but are bent in an adoral direction in the sutural (adapical) region. In the lectotype (pl. 8, fig. 1a, b) of the type species of *Molopophorus*, *Bullia* (*M.*) *striata* Gabb, 1869 (*ANSP* 4249), the growth lines are bent away from the aperture in the sutural region, which appears to be canaliculate, as in *Brachysphingus* (pl. 8, figs 3, 4). The same feature is shown by *U.Cal.* 7182–30750

(pl. 8, fig. 2). However, another specimen figured as *Molopophorus striatus* by Dickerson (1915 : 67, pl. 8, fig. 6, given as fig. 7 in explanation to the plate) seems to be misidentified and is almost certainly a *Colwellia* (pl. 7, fig. 10).

The type of growth line found in *Molopophorus* (s.s.) and *Brachysphingus* is also found in *Cyllene*, a rare living genus of Nassariidae. This feature is found in other widely-separated prosobranch superfamilies and is often associated with a gutter or canaliculate suture which accommodates a posterior filament as in *Oliva* (Volutacea) (Tryon, 1883, pl. 3) and *Terebellum* (Strombacea) (Jung & Abbott, 1967, p. 446, pl. 319).

Sections through the columella of *Brachysphingus* show that it lacks the terminal plait found in all definite Nassariidae including *Cyllene*. Although no specimens of *Molopophorus* s.s. were available for sectioning (the lectotype is the only specimen in the ANSP collections—Dr H. G. Richards, personal communication), the external similarities of the two genera are so great that it is doubtful if either belongs to the Nassariidae. Their general shell features including the fasciole ridge and reverse S-shaped growth lines suggest that they may best be placed in the very broad Buccinidae (*sensu* Wenz, 1941–1943).

In fact, it seems that *Molopophorus* (Gabb, 1869 : 156) is a synonym—based on immature material—of *Brachysphingus* (Gabb, 1869 : 155), which is here selected as generic name of the taxon.

A large number of North American west coast Tertiary species ranging in age from the Meganos Formation (lower Eocene) of California (Clark & Woodford, 1927 : 117) to the Miocene of Washington State (Weaver, 1942 : 463–471) have been assigned to *Molopophorus* and the genus is also recorded from the Oligocene and Miocene of Japan (Oyama, 1960 : 73–74). These species differ considerably in form. Vokes, moreover, (1939 : 140–141) mentions that there were two or three distinct types of nuclear whorls among the Californian species ascribed to *Molopophorus* and suggested that they were unlikely to be congeneric. Most of these species need assigning to new genera—a task beyond the scope of this work. It would appear, however, that they are fairly closely related to the European forms described herein and would also seem to belong to the Nassariidae.

Gabb (1864 : 97) described *Nassa cretacea* and *Nassa antiquata* both of which have been regularly assigned to *Molopophorus* by American workers in this century. Nevertheless, he himself still assigned them to *Nassa* (1869, 219) in the paper in which he described *Molopophorus*. The difficulties of interpreting *Molopophorus* correctly have hindered workers who have suspected a connection between it and European species previously assigned to *Cominella*.

We have assigned to *Colwellia* only those American species which have a very strong resemblance to *C. flexuosa* and *C. auversiensis*.

In *Desorinassa* the ramp is convex and the collabral sculpture weak. In *Colwellia* the ramp is concave and the collabral sculpture is much stronger on the earlier whorls. *D. williamsi* (Ypresian) and *C. auversiensis* (Auversian) appear to form a link between the two genera.

The differences in the protoconch, given in the diagnosis, are sufficient to distinguish *Colwellia* from *Keepingia*, which almost certainly arose from it.

## *Colwellia flexuosa* (Edwards, 1866)

(Pl. 7, fig. 1–5)

1866 *Cominella flexuosa* Edwards *in* Lowry, Etheridge & Edwards, pl. 3.
1880 *Cominella* (*Buccinum*) *flexuosa* Edwards MS; Judd: 154.
1881 *Cominella* (*Buccinum*) *flexuosa* Edwards MS; Keeping & Tawney: 105, 116.
1889 *Cominella flexuosa* Lowry; Bristow: 290.
1891 *Cominella flexuosa* Edwards MS; Newton: 168.
1921 *Cominella flexuosa* Edwards; Wrigley: 139.
1926 *Cominella flexuosa* Edwards; Jackson: 356.
1963 *Cominella flexuosa* Edwards *in* Lowry; Glibert: 67.

Lectotype (designated herein). Upper Eocene, late Priabonian, Middle Headon Beds (presumably *Venus* Bed), Colwell Bay, I.O.W., GG 19709/1 (*Ed*).

Paralectotypes (designated herein). Same details, GG 19709/2–30.

Material studied. Restricted to Middle Headon Beds. *Venus* Bed, Colwell Bay, GG 19710/1–11 (*Wr*); GG 19711 (*Nu*); (*Cu*); (*S*); *Sand. Mus.* 4778, 748; *Sedg. Mus.* C 28281–4 (*K&T*). Headon Hill, I.O.W., GG 19712/1–3 (*StJB*); *Sedg. Mus.* C 28645–9 (*K&T*). *Venus* Bed, Whitecliff Bay, I.O.W., GG 19713 (*Cu*). Brockenhurst Bed, Brockenhurst, GG 19714 (*Ed*).

Further occurrences. Unknown.

Diagnosis. *Colwellia* with narrow sloping subsutural collar and rather broad concave subsutural ramp; mean spire angle between 55° and 70°; angular cancellate ribbing on early whorls, becoming almost smooth, particularly below periphery of last whorl; outer lip often weakly denticulate within; obvious sinus in growth lines of peripheral region, and in some specimens a posterior siphonal notch, developed at maturity.

Description. The protoconch is worn in all specimens, the junction with the teleoconch cannot be seen. The aperture is slightly more than two-thirds shell height. The teleoconch consists of up to five whorls. The suture normally lies on the periphery, sometimes on later whorls it lies just below as the sutural slope increases slightly. Below the rounded subsutural band the very slightly concave ramp slopes away to the shoulder. Three or four weak spiral ribs occur on and below the shoulder of spire whorls; that on the shoulder is the strongest. These ribs become noticeably weaker on the last whorl. Up to two more spiral ribs, which are usually weaker, may occur on the ramp. Between five and ten rather widely spaced spiral cords are present on the neck of the body whorl. The collabral ribs are stronger than the spiral ones and are like crested-waves in cross-section. There are about twenty-one collabral ribs on the spire whorls of the teleoconch. On the first half of the body whorl there are about sixteen increasingly weaker ribs. Collabral ribbing becomes virtually obsolete on the final half whorl. The main indication of its presence is slight axial nodes on the spiral ribs. Similar nodes are formed on the spire whorls where the collabral and spiral ribs intersect giving a rather cancellate appearance. In some specimens the outer lip is smooth internally, in others there are up to fifteen unevenly spaced weak denticles about 1 mm long

and set about 1 mm inside the aperture, and a few shells show another row of denticles about 45° inside the aperture. As well as the broad sinus in the growth lines of the peripheral region of mature specimens there is a slight posterior siphonal notch developed in the outer lip where it meets the suture (pl. 7, fig. 2c). Its strength seems related to the size of the shell and it is sometimes absent in smaller specimens. It may be presumed to mark the reaching of full growth as there is no trace, except occasionally on the last quarter whorl, of its previous existence on earlier growth lines. In a few specimens the colour pattern is clearly visible under ultra-violet light. A pair of spiral bands, about 0·5 mm wide, separated by about 0·2 mm lie on the periphery (thus appearing just above the suture on spire whorls). Another pair of bands, about half the breadth, occurs at the top of the neck.

| Dimensions. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GG 19709/1 LT | 14·2 | 9·5 | 9·0 | 5 | 14 | 22 | 14 | 6 | 5 | 1·49 | 1·58 |
| GG 19713 — | 5·4 | 3·3 | 3·2 | 3 | 17 | 20 | 5+ | 4 | 0 | 1·63 | 1·68 |
| GG 19709/6 PLT | 10·8 | 6·8 | 6·6 | 4½ | 22 | 22 | 12+ | 4 | 0 | 1·59 | 1·64 |
| GG 19709/2 PLT | 14·3 | 8·3 | 8·6 | 5 | 22 | 21 | 12+ | 7 | 6 | 1·72 | 1·66 |
| GG 19709/4 PLT | 14·9 | 9·4 | 9·2 | 5 | 18 | 23 | 15+ | 7 | 0 | 1·58 | 1·62 |
| GG 19709/3 PLT | 20·1 | 13·0 | 11·2 | 6 | 9 | 25 | 28 | 10 | 15 | 1·55 | 1·79 |

(see p. 192 for key)

Remarks. Following Wrigley's (1921 : 139) reasoning, we ascribe the authorship of this species to F. E. Edwards. Its resemblance to the earlier *C. auversiensis* (Deshayes) (pl. 7, figs 6, 7) is striking. Both species have teleoconchs so similar to those of *Keepingia* that it is necessary to compare them with both *K. gossardi* (Nyst) (pl. 8, figs 5–7) and *K. cassidaria* (Sandberger) (pl. 8, fig. 9). *C. auversiensis* differs from both *C. flexuosa* and *K. cassidaria* in being less tumid, having a less concave ramp and less marked shoulder whilst its collabral sculpture, though weaker on early growth stages is more persistent and its growth lines less flexuous. Sandberger figures two varieties of *K. cassidaria*. The first (1863, pl. 20, figs 1, 1a, 1d, 1e) is characterized by about four strong spiral ribs on the spire whorls and about ten on the body whorl. It lacks collabral sculpture on the last and sometimes on the penultimate whorl. The second variety (1863, pl. 20, figs 1b, 1c) which he refers to (p. 230) as var. *cancellata*, is less common in B.M.(N.H.) collections. It has a cancellate appearance; the primary spiral ribs are separated by secondary ones and numerous collabral rugae are developed. Both forms of *K. cassidaria* may be readily distinguished from *C. flexuosa* by their sculpture. *K. gossardi* differs from *C. flexuosa* by being larger and having a relatively smaller aperture, less sinuous growth lines, and more definite subsutural collar with a tendency for the suture to be canaliculate. The sculpture of *K. gossardi* is much stronger and persists to maturity. It has numerous spiral ribs and about fifteen collabral folds per whorl.

Two specimens in the F. E. Edwards Collection (GG 19725–6) were labelled by Edwards as being from the Bracklesham Beds of Brook, Hampshire. The first was correctly identified as *flexuosa* and appears from the matrix to be from the Brockenhurst Bed of the Brockenhurst area. The second is likely to be from Brook but is a young *Strepsidura turgida* (Solander). The sculpture on the spire whorls of

these two species is remarkably similar. Edwards' label may have caused Keeping & Tawney (1881 : 105, 116) to indicate that the species occurs in strata older than the Headon Beds.

There is a remarkably small variation in size of the known specimens. Most of those in B.M.(N.H.) collections lie between 12 and 16 mm in height. The largest and smallest specimens whose dimensions are given here are exceptional.

## *KEEPINGIA* gen. nov.

(Pl. 8, figs 5–9)

TYPE SPECIES. *Buccinum gossardi* Nyst, 1836.

DIAGNOSIS. Agrees with *Colwellia*, except in the following respects; sometimes exceeding 20 mm in height; protoconch initially slightly heterostrophic, of one and a half smooth whorls, separated from teleoconch by a whorl on which there are about 20 decreasingly opisthocline collabral folds, with spiral sculpture developing on later part.

OTHER SPECIES ASSIGNED. ***Cominella annandalei* Vredenburg 1925; ***Cominella aturensis* Peyrot, 1927; *Buccinum bolli* Beyrich, 1854; *Buccinum cassidaria* Sandberger, 1863; ***Cominella praecedens* Peyrot 1927; *Nassa tarbellica* Grateloup, 1834; ***Buccinum uniseriale* Sandberger, 1863. (See p. 201 for explanation.)

GEOLOGICAL RANGE. Lower Oligocene (Late Lattorfian) to Lower Miocene (Burdigalian).

REMARKS. The similarities of the teleoconch suggest that *Keepingia* is close to *Colwellia* but its consistently different protoconch in all species examined justifies its separation. It is the only genus described herein that survives into the Miocene. The first occurrence is of the type species in the Upper Tongrian Henis Clay of Belgium, the species persists into the Rupelian of Belgium and France. The last definite occurrence of the genus is that of *K. tarbellica* in the Burdigalian of the Bordeaux basin.

As indicated above, no specimens of four of the species listed were available for study, so the stratigraphical and geographical range of the genus as shown on Table 1 can only be tentative. This is particularly unfortunate in the cases of *C. annandalei* from the Nari (Oligocene) of the Indian sub-continent. No species are known from England.

## *THANETINASSA* gen. nov.

(Pl. 9, figs 1–7)

TYPE SPECIES. *Buccinum bicorona* Melleville, 1843.

DIAGNOSIS. *Phos*-like, relatively tall, up to about 20 mm high; teleoconch of up to six whorls; mean spire angle of about 45°; aperture about half shell height; strong,

slightly sloping, subsutural platform developed; both spiral and collabral ribbing strong, with beads produced at intersections; outer lip notably convex, only slightly produced anteriorly; growth lines markedly recurved in neck region immediately prior to terminal aperture, to form a 'stromboid-like' notch, associated with particularly strong spiral ribbing; columella bent to the right above a terminal plait; growth lines of fasciole as in *Desorinassa;* columellar and parietal callus weakly developed.

Other species assigned. None.

Geological range. Palaeocene (Thanetian).

Remarks The strong 'stromboid-like' notch developed at the final aperture immediately distinguishes this genus from the others described in this paper. All these have a slight sinuosity in a similar position, but nothing so marked. In living *Strombus* the notch accommodates the right eye peduncle.

Both *Phos* and *Nassarius* s.l. have similar notches. It is always strong in *Phos*, but is of variable strength in *Nassarius*. The eye tentacles of *Phos* are joined at their base to form a Y-shaped structure (Tryon, 1881 : 215, pl. 83, fig. 484), in *Nassarius* (Tryon, 1882, pls 7, 9, 12, 14, 15, 18) the arrangement is rather similar. It seems possible that this structure as a whole, rather than a single tentacle, lay underneath the notch.

It is hoped that the relationship between the Nassariidae and the *Phos*-like genera which were assigned to the Buccinidae by Wenz (1941) will be discussed in a future paper in greater detail than would be appropriate here. The curved columella, the form of the columellar plait, with its strong posterior boundary ridge and the broad fasciole of *Thanetinassa* are very similar to those of contemporary *Desorinassa*, which differs in having very weak sculpture The later genus *Pseudocominella* is strongly sculptured and *P. solanderi* is similar in shape and size to *T. bicorona*. Any similarity in their sculpture, however, is superficial. Moreover, the columellar and fasciole features of the two genera are very different.

*Thanetinassa* should be compared with *Buccitriton* and *Tritiaria* (both assigned by Wenz, 1941 : 1177–1178, to the Buccinidae) and *Sagenella* (tentatively assigned by Wenz, 1943 : 1224, to the Nassariidae) All three genera occur in the Lower Tertiary of the South-Eastern United States. In all three the fasciole is bounded posteriorly by a much weaker ridge than in *Thanetinassa*, and the stromboid notch is either weak or absent and is never associated with strong spiral ribs. In *Buccitriton* the columella is short, terminating well above the most anterior part of the shell, which in this case is the outer lip. In *Thanetinassa*, on the other hand, the terminal columellar plait forms the most anterior portion of the shell. In *Tritiaria* the fasciole is much narrower than in *Thanetinassa* and is spirally striate.

### ***Thanetinassa bicorona*** (Melleville, 1843)

(Pl. 9, figs 1–7)

1843 *Buccinum bicorona* Melleville: 12, 73, pl. 10, figs 4, 5.
1850 *Buccinum bicorona* d'Orbigny: 303.
1865 *Buccinum quoesitum* Deshayes: 503.

1866 *Buccinum quoesitum* Deshayes: pl. 93, figs 9–12.
1889 *Cominella bicoronata* (Melleville) *nom. mut.* Cossmann: 138.
1901 *Cominella bicorona* (Melleville); Cossmann: 150.
1911 *Cominella bicoronata* (Melleville); Cossmann & Pissaro, pl. 37, fig. 178–7.
1934 *Cominella bicoronata* (Melleville); Cooper: 7.
1963 *Cominella bicorona* (Melleville); Glibert: 66.

Material studied. England, Palaeocene, Thanetian, Upper Thanet Sands' *Corbula* Bed. Herne Bay, Kent, G 57073–8 (*J. E. Cooper Colln.*). Bishopstone' Herne Bay, G 60746 (*J. E. Cooper Colln.*); GG 19741/1–2 (*Wr*); GG 19742 (*Wr*); GG 19743 (*A. G. Davis Colln.*). Bishopstone Gap, GG 19744 (*Ru*). *Arctica morrisi* Bed, foreshore exposure approx. 400 yards E. of Bishopstone Gap, GG 19745 (*Ru*). France, Palaeocene, Thanetian, Châlons-sur-Vesle, Marne, G 19357/1–4 (*L. Staadt Colln.*); GG 19740 (*Wr*); 5 shells *EMP* (*Deshayes Colln.*).

Further occurrences. France, Sable Inférieurs (Thanetian). Type locality Villiers-Franqueux (Melleville, 1843 : 73). Châlons-sur-Vesle, Brimont, Jonchery (Deshayes, 1865 : 503; Châlons-sur-Vesle (Briart & Cornet, 1871 : 31); Châlons-sur-Vesle, Chenay, Jonchery (Glibert, 1963 : 66).

Diagnosis. As for genus.

Description. All the specimens are fragile, abraded, and with their earlier whorls either missing or decorticated. It is impossible therefore to separate the protoconch and teleoconch. GG 19741/2, however, is 12·3 mm high and has eight whorls. Neither definite ribbing nor the subsutural platform appear until the fourth whorl, so the first three may well comprise a rather acutely-spired, naticoid, protoconch. Most of the spiral ribs are distinctly weaker than the collabral ones and the preservation in all specimens is such that spiral ribs cannot be seen until the third teleoconch whorl. Up to nine spirals ribs occur on the spire whorls and about twenty on the body whorl. The two strongest, which are stronger than any of the collabral ribs, are those forming the sloping subsutural platform and the shoulder. The concave ramp is formed in the interspace between these two ribs. Sometimes two or three other fairly strong ribs occur on the neck above the fasciole, marking a backwardly-directed fold in the growth lines. Sometimes a weak rib is developed above the main rib of the subsutural platform. The collabral ribs are more or less orthocline and decrease in strength below the periphery; on some specimens they may be seen to follow the above-mentioned fold on the neck. They are prominent, steep-sided, and separated by interspaces nearly twice their width. Their number remains fairly constant, throughout growth. On the last whorl, their spacing becomes less regular. An irregular, varix-like, pre-terminal aperture is often developed just after the commencement of the last whorl, being situated on the ventral surface of the shell, slightly to the left of the final aperture. Similar varices may well be developed later on the last whorl, GG 19744 having a total of five. Two weak spiral ribs are occasionally developed on the fasciole. Spiral ribbing has not been seen within the outer lip.

| Dimensions. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GG 60746 | | 18·5 | — | — | — | — | — | 19 | — | — | — | — |
| | estimated | 20·0 | — | 9·0 | 6 | 25 | — | — | — | — | — | 1·77 |
| G 1974/1 | | 17·5 | — | 8·0 | — | — | — | 19 | 9 | — | — | — |
| | estimated | 18·5 | — | — | 6 | 22 | — | — | — | — | — | 2·31 |
| GG 19741/2 | | 12·3 | — | 6·0 | 5–6 | 15 | 20 | 20 | 8 | — | — | 2·01 |
| GG 19357/1 | | 15·5 | 8·5 | 8·3 | 6 | 23 | 24 | 18 | 8 | — | — | — |
| | estimated | 16·0 | — | — | — | — | — | — | — | — | 1·88 | 1·93 |
| GG 19357/2 | | 14·6 | 7·0 | 8·3 | 6 | 19 | 19 | 21 | 8 | — | 2·08 | 1·76 |
| GG 19357/3 | | 12·8 | 6·0 | 6·3 | 6 | 23 | 21 | 16 | 7 | — | 1·70 | 1·61 |

Remarks. The English specimens are notably more strongly varicate on the last whorl than those from France. There are, however, no other apparent grounds for specific separation. This species strongly resembles *Buccinum montense* (pl. 9, figs 8a, b) described by Briart & Cornet (1871 : 30–31) from the Montian 'Calcaire Grossier' of Mons; they compare the two species in detail, and both were subsequently assigned to *Cominella* by Cossmann (1901 : 150). Examination of the fasciole of *Buccinum montense* from Mons (GG 71604–7, *Chavan Colln.*) show that this species is not a member of the Nassariidae but is congeneric with European Eocene and Oligocene species assigned to *Pollia* of the Buccinidae.

Cossmann (1889 : 138) placed *B. quoesitum* Deshayes (1865) in the synonomy of *B. bicorona* Melleville (1843) remarking that Deshayes had overlooked the earlier name. The whereabouts of Melleville's specimens is unknown but his figures (1843, pl. 10, figs 4, 5) appear to agree with those of Deshayes (1866, pl. 93 figs 9–12) and Deshayes' surviving specimens all from Châlons-sur-Vesle (*EMP*). Melleville's locality was Villers Franquex, at which the only horizon exposed is the middle fossiliferous zone of the Sables de Châlons-sur-Vesle (Fritel, 1910 : 332).

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